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The Mining Journal

London, November 20, 1959

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Aid for Developing Countries

IRRESPECTIVE of political or humanitarian considerations, manufacturing nations have a direct economic interest in maintaining the flow of capital to the less developed territories whose economic expansion is one of the keys to the growth of world trade.

Since the war the United States, with assistance from Britain, has come to be regarded as the universal Free World provider of foreign aid. The U.S. Administration, however, as part of its drive to reduce America's trade deficit—likely to amount this year to over \$4,000,000,000—is endeavouring to curtail the size of its own aid programme by persuading other Western countries to carry a greater share of the burden.

Particularly welcome in these circumstances is Mr. Heathcoat Amory's timely survey of Britain's expenditure on economic and technical assistance to developing countries, given last week at the Lord Mayor's dinner to the bankers and merchants of the City of London.

In the first place, said the Chancellor, the United Kingdom has given strong support to such international moves as doubling the authorized capital of the World Bank and the creation of an International Development Association, to operate as an affiliate of the World Bank and to supplement its lending operations. It has also acted independently through such channels as the Commonwealth Assistance Loans and the arrangements for Exchequer loans to Colonies.

The aim of the new Commonwealth Assistance Loans, announced at the Montreal Conference last year, is to aid the less developed countries, and those newly becoming independent, who have not had time to establish their credit as firmly as would be needed to borrow successfully in London or other world markets. On Exchequer loans to the Colonies, Parliament has authorized the approval of loans up to a total of £25,000,000 each year in the period 1959-64, with a maximum of £100,000,000 over the five years as a whole. The C.D. and W. Acts have also been extended for a further four years and provide an additional £95,000,000, making £139,000,000 available for the period 1959-64.

Total United Kingdom expenditure from public funds on economic and technical assistance to all overseas countries and territories, including funds channelled through international institutions, has risen from £75,000,000 in 1957-58 to roughly £100,000,000 in 1958-59. These figures are exclusive of certain other funds provided to these countries for military assistance, special emergency relief, etc., which have been running at about a further £30,000,000 a year. In the current year, 1959-60, a further substantial increase in our expenditure on economic and technical assistance is taking place.

As the Chancellor was careful to point out, new development can never be effectively carried out by Government funds alone, but depends first and foremost on the flow of private capital, guided by the skill and initiative for which the City of London had always been justly famous. Private investment by the United Kingdom in other countries, mostly within the Commonwealth, has been running at

the rate of £300,000,000 a year gross, or £200,000,000 if allowance is made for foreign investment in this country.

Having regard to our limited population and resources, Mr. Heathcoat Amory's claim that the United Kingdom is carrying its full share of the burden of foreign aid can scarcely be refuted. There must also be general agreement with his statement that, if we are to go on playing our part in this way, we must be sure that our economy is strong. "We cannot lend abroad," said the Chancellor, "unless we can meet the call thus made on our resources and on our balance of payments. To overstrain our resources would merely undermine our capacity to provide help in the future."

The importance of a balanced approach to investment overseas was also stressed by Lord Chandos, chairman of Associated Electrical Industries, in a recent address to the Royal Commonwealth Society. The under-developed countries, said Lord Chandos, can only be developed by the surpluses and by the export of the skill and capital of the developed ones. From this the conclusion might be drawn that the creation of surplus wealth for investment in the developed countries was the first duty of the capitalist. Moreover, as the speaker further pointed out, it is usually the exploitation of discoveries in the most advanced countries which offers what are really the most attractive investment opportunities.

Lord Chandos rightly rejects the case for maximum investment in research and development at home on both humanitarian and political grounds. However, given the shortage of capital throughout the world, he regards it as essential that, when investing in the Commonwealth, the humanity of our outlook should be tempered by realism in the nature of our investments.

With this conclusion there can also be little quarrel, so long as we are quite clear in our minds as to precisely what constitutes realism in overseas investment. Presumably it implies, in the first place, that, other considerations being equal, the Government in spending public money overseas, should give priority as far as possible to those projects which are likely to give the British taxpayer the greatest value for his money; for example, by offering likely outlets for the export of British know-how and capital equipment.

So far the flow of capital from the U.K., whether private or public has not been tied to exports. The British Government, to use the Chancellor's words, believes "that this policy, so long as others will follow it, too, is the best policy, both for the recipients of capital who can thus buy in the cheapest market, and for the exporting countries who will benefit from free and healthy competition."

On an idealistic basis, there is perhaps much to be said for the adoption of such a liberal approach to foreign aid, always provided that a similar policy is followed by the other countries which are our competitors. In the United States, however, the Development Loan Fund was recently placed under a "Buy American" policy, which means that future recipients of its "soft" loans will normally have to spend them on U.S. goods and services. There can be little doubt that, as the Western European countries and Japan step up their overseas spending, the U.S. example will tend to be more widely followed. In fact, the time may be coming when foreign aid will have strings attached to it as a matter of course.

From the point of view of the recipients, no less than the lenders, it is vital that there should be a realistic appreciation of the need for proper technical consultative assistance to avoid the deplorable waste of funds which has occurred in the past. More especially, from the standpoint of the British consultant, it is essential, when loans or grants are made to developing countries, that provision should be made for some form of tie-up which will bring him into the picture when the cheque is signed.

SWEDISH IRON MINE RE-OPENED

Automatized and equipped with what is claimed to be the most modern mining machinery in Europe, the old Strassa iron mine, in Central Sweden, disused since 1923, was re-opened on October 29. This re-opening is part of a scheme of the Grangeberg Company for using part of the funds received from the Swedish Government in respect of its share in the Lapland ore fields taken over by the latter for a revival of the "Bergslaget" mining region.

This large scheme comprises more than the mere re-opening of old mines in that region. It is a tight-fitting arrangement of mining, enriching and processing at new, up-to-date plants, which include an iron works with an initial annual capacity of 300,000 tonnes of finished plate, now nearing completion at Oxelosund, on the Baltic coast, south of Stockholm.

The estimated annual output of Strassa is 1,100,000 tonnes, making it the fourth largest mine in Sweden. Its ore reserve, it is calculated, will last for at least 100 years, and the ore, after enrichment—in what is claimed to be the largest enrichment plant in Europe—will have an iron content of 68 per cent. New methods of ore-concentration and enrichment, largely evolved by the Grangeberg Company's own engineers, are the basis of this mine. The former will have to be done by several methods, as the local ore contains 80 per cent of magnetite and 20 per cent of red iron ore.

The mining process, too, presents some new and interesting features. A novel type of Atlas-Copco drilling machine, with exceptionally long Coromant-tipped steels, will be used for bench-driving from below the outcrops, in a V-like, upwards-outwards fashion, so that after the round, the ore slides down the slanting walls for loading. The drills can make holes of up to 35 metres (115 feet). The record, so far, is stated to be 250 metres by one man in a single shift.

TIMELY WORDS ON COAL

It so happened that, simultaneously with the news that the aggregate borrowing powers of the National Coal Board were to be raised by £100,000,000 and the period covered to be extended from August, 1961, to the end of 1965, there arrived on our desk a booklet containing the addresses delivered by Sr. Piero Malvestiti at the inauguration of the High Authority of the European Coal and Steel Community in September last. Sr. Malvestiti recalled that, as early as February 1955, the High Authority had noted in a memorandum that the Community's coal was no longer the only source of energy, but was threatened by competition from other products and other sources of supply.

He went on to quote from the High Authority's fifth general report and its second Memorandum on General Objectives, published in March, 1957, which contain several highly valuable and still more timely observations. The share taken by coal in covering the Community's energy requirements is constantly diminishing, pointed out these reports. Cyclical fluctuations in demand for coal are more marked than those in total energy consumption, and coal production varies little, in spite of the fluctuations in demand. Finally, the possible variation in the prices of coal produced is smaller than the variations in the prices of oil products. The conclusion is obvious: coal production must be economic if it is to make the contribution to general economic expansion expected of it.

After emphasizing by further quotations from past reports that the situation had been recognized, studied and diagnosed in good time and with great clarity, Sr. Malvestiti asked how it was possible that today pithead stocks of coal were stationary and even increasing. "It may be said," he went on, "that the strong demand for coal and the high freight rates of the

1954-57 period may have misled people; that because the market was absorbing even the lowest quality production, not only was the progressive closing of marginal pits not carried out, but long-term import contracts were concluded with the U.S.; that, in any case, all long-term forecasts appeared to indicate that energy requirements—coal included—were continually increasing."

"It seems paradoxical to me," he commented, "that in our time, strictly technical data tend to convince some people more than reasoned economic argument. It cannot be repeated often enough that, in anything connected with the economy, the fundamental problem is not technical but economic."

"It is extremely difficult to divert the producer's attention from production to demand, especially when demand has for decades or centuries taken a routine course and followed traditionally constant curves; or, to put it more precisely, it is difficult to divert the producer's attention from costs to prices. It is true that costs are a decisive element in price formation; but it is less correct to say that they are the only factor which determines prices."

Looking to the future, Sr. Malvestiti emphasized the weakness of an optimism based on the ostrich-like policy of hiding one's head in the sand to avoid seeing danger. "Our task," he declared, "is not only to see reality, but to look at it with wide-open eyes. This reality teaches us that the entry into the market of new forms of energy cannot be prevented, and also that no illusions should be entertained as to what the consumer's choice will be. Wherever a modern industrial enterprise can avoid using coal, it will do so without hesitation. Finally, the transport services are abandoning the use of coal."

"It would be foolish, however," he concluded, "to assume that this valuable source of energy will be abandoned altogether. There are production processes for which coal is technically irreplaceable. Metallurgical coke is quite indispensable, as for instance in certain metal reduction processes, in the treatment of certain electric furnace products, and finally because the by-products of coal distillation have become a raw material for the chemical industry. Coal, therefore, still has a future, particularly if maximum productivity can be achieved by judicious means and in good time. As for the costs, they will inevitably adjust themselves under the influence of world-market prices."

These are words which merit the close attention of all who still believe that the problems of the coal industry in Britain or elsewhere can be solved by such uneconomic measures as increasing borrowing powers, piling up more unwanted stocks, or interfering with the consumer's freedom of choice by restricting imports of competitive fuel, as has been advocated in certain quarters.

A CENTURY OF MINING PROGRESS

Production in 1958, the centennial year, brought the accumulated value of the mineral output of British Columbia well past the \$4,000,000,000 mark, records the Minister of Mines for the Province in his annual report. The statistics of mineral production for 1858 show only coal valued at a few thousand dollars and placer gold valued at \$705,000. For 1958, 38 items are listed; 15 under metals, 7 under industrial minerals, 13 under structural materials, and three under fuels. Their combined value is \$146,875,081, placer gold and coal combined contributing slightly more than 4 per cent of the total. Lead contributed 23.6 per cent and zinc 29.4 per cent of the value of the 1958 mineral output.

The number of lode-mineral claims recorded in 1958 was 13,459, compared with 12,110 in the previous year. The report points out that lode-mine exploration increasingly is carried on by large companies doing geological, geophysical

and geochemical work, stripping with heavy equipment, diamond drilling, and often meeting transportation problems by using fixed-wing aircraft or helicopters. These procedures contrast with the traditional ones that were responsible for most lode discoveries in the past. Except for the Cassiar Asbestos property, however, the new mines of the post-war period are old discoveries which determined and intelligent effort and increased prices have made profitable sources of mineral wealth.

MOZAMBIQUE'S MINERAL RESOURCES

During a recent visit to South Africa, the Portuguese Minister for Overseas Territories, Rear-Admiral Vasco Lopes Alves, stated that present development in Mozambique was such that the territory could find employment for all its Africans should South Africa decide to dispense with the labour it annually imports from Portuguese East Africa, whether for the mines or otherwise. The Minister also stressed that the considerable sums which the next Development Plan (1960-1965) allocated to the development of Mozambique would benefit primary as well as secondary production, since much research into the possibilities of mining was being considered.

A survey of the territory's mineral resources appears in a recent issue of *East African Trade and Industry*, which points out that the coal mining industry in Mozambique is as yet on a small scale. Coal at Moatize in the Zambezi Valley near Tete is of fair quality, and somewhat like Wankie coal in type. The mines could supply appreciably more than the present demand on them.

The deposits available are considerable, consisting of 700,000,000 tons. In the year 1955 the output was about 160,000 tons. It would also seem that there is coal in the Limpopo Valley, near the line joining Lourenço Marques to the Rhodesian Federation at Espungabera.

In the Espungabera district nothing has as yet been published on the quality of the deposits, which are vast and extend into Rhodesian territory.

Thus, Moatize, with a highly mechanized installation, remains the only coal-mine in Mozambique. Its extraction rate is, however, increasing: in 1953 the figure was 161,673 tons and in 1956 this had reached 218,299 tons. By 1960 it will probably be close on 300,000 tons. All coal produced is locally consumed, and in addition Mozambique still has to import South African coal. The future could see the province self-sufficient in this respect.

Large deposits of magnetite are found in the Tete area, which seems to be, as far as is known at present, the melting pot of all minerals in Mozambique. These deposits are, as yet, of little value owing to their high titanium content, and titanium is difficult to separate from iron.

Radioactive minerals are again found in the Tete district, and also in the Alto Ligonha district some 100 miles southwest of Mozambique Island. Prospecting and mining rights are reserved to the "Junta da Energia Nuclear" (Portuguese Atomic Energy Commission). Thirty-nine tons were extracted in 1957, with a content of between 5 and 7 per cent of U_3O_8 . Davidite and thorium also exist in the Alto Ligonha, but are not yet exploited.

A quantity of other minerals is known to exist in Mozambique, but as against this the known deposits are small and sporadic, or are not economic to exploit. A few mine owners have made a fair return out of their "one-man" workings, but little of real benefit to the country has been found.

Meanwhile, great strides are being made in electrification, as an essential preliminary to development of the country's resources.

AUSTRALIAN MINE TAX—I

Taxation in the Australian Mineral Industries

IN analyzing the problems of the mineral industry down the years, the writer has kept always in the foreground one over-riding objective—national development. Modern industrial development is based fundamentally on mineral raw materials; that, in itself, provides sufficient reason why the mineral industry must be given special consideration in administrative thinking. Action which inhibits national development at any point should be avoided, or, if essential as a temporary measure, must be modified as soon as possible to remove the inhibition. On the other hand, whatever reasonable action is advisable to stimulate mineral development should be pursued energetically. Considerations relating to this over-riding objective of development enter into many problems associated not only with taxation but also with such matters as royalties, export and import controls, tariffs, international agreements, and the varied matters which compose national administration. Of course, the extent of the effect which a particular action may have on development is not always immediately apparent; that is particularly so where the action is concerned with taxation.

There are four obvious but very sound reasons why we may claim that taxation in the mineral industry should be treated differently from taxation in other industries:

1. The very high risk associated with investment in the mineral industry as compared with investment in other industries.
2. Mining is the only industry based on a wasting asset.
3. Taxation is a factor which affects the total national reserves of a mineral.
4. Until the shareholder's investment is recouped in dividends, taxation adds to the hazard of the return of his capital.

Maybe the difference in taxation treatment between the mineral and other industries was not so important 20 years ago when taxation rates were low, and when prospecting and mining development were not so costly and the financial hazards were not so great. But, with the high taxation rates of today, and the increasingly higher risk and far greater investment in exploration and mining and treatment, it is imperative that old principles be re-examined and that taxation be adjusted to the special requirements of the mineral industry.

The maximum financial risk is in exploration as distinct from productive mining. Nowadays, the scope for finding new outcropping mineral deposits is virtually nil, except perhaps in very remote regions. The search for hidden deposits, requiring scientific and technical staff using costly equipment, imposes such a high financial risk that it should never be considered from any point of view other than that of a gamble with very long odds indeed. Naturally, the investor hopes for a commensurate award on the very rare occasions that his gamble is successful.

When a mine is to be established on a new deposit the degree of financial risk is not so great as in exploration; nevertheless, the risk is still very considerable and the actual amount of finance required is generally far greater than for prospecting. Several factors are responsible for the high risk of mineral investment:

1. The uncertainty commonly associated with the extent of the reserves and the grade of ore.
2. The uncertainty in anticipating future costs, particularly in the isolated regions in which many mines are located.

This article, the first of a series of four, outlines the reasons why mineral investment is far more hazardous than other forms of investment and why taxation in the mineral industry should be on a different basis from taxation in other industries. The author goes on to summarize the provisions of the Australian Income Tax Act as they relate specifically to the mineral industry. The series is reproduced by courtesy of *Chemical Engineering and Mining Review* and has been abridged.

3. The uncertainty of the life of the mine in relation to amortization of capital.

4. The uncertainty whether the competitive position of the mine and treatment plant may be weakened by the opening of other mines and treatment plants elsewhere, in the future.

5. The serious uncertainty of extreme price movements so characteristic of mineral raw materials.

Further, per ton of production capacity, the capital cost of plant in the mineral industry is commonly very high indeed: for example, per ton of aluminium produced annually, the total capital investment may be of the order of £1,000, or several times the market price of the metal, so that amortization necessarily represents a high proportion of the metal's price. This aspect is enhanced by the fact that, in world mining, the norm of production capacity must necessarily be in excess of demand in order to ensure adequate supplies of raw materials to secondary industry—thus, it is normal for mining and treatment plants to work continually below capacity.

In Australia, there is also an additional important feature bearing on labour—a very large part of the country lies in the tropics, and Australian mines located in that region are the only tropical mines in the world employing exclusively white labour.

These factors add up to a formidable deterrent to investment, on a scale not associated with any other form of investment.

The reserves of each mineral deposit are ultimately finite. Every ton of ore removed reduces the reserves and the life of the mine. No other industry is based on the irretrievable depletion of the asset which provides the industry's revenue—even forestry is not comparable for re-forestation is possible whereas rejuvenation of a depleted orebody is impossible.

Just as the orebody itself has a capital value, so also has every ton of ore removed. That value is not merely the value when the mine was first developed or purchased, but varies during the mine's history, according to the mineral's market value and to the economic factors associated with the region in which the mine is located. Thus, as the ore is mined and sold, the surplus of earnings over cost may rightly be considered as divisible into two parts: the capital value of the ore produced and the real profit on the operation.

To investors in a mining company, company tax is a definite item of cost. Any reduction of income tax paid by the company is a clear contribution to reduction of costs up to the point of dividend distribution, and may permit the lowering of grade of ore which can be mined, leading to an increase in reserves. From the national point of view, it becomes axiomatic that the lower the company tax, the greater the national mineral reserves.

By Dr. J. A. DUNN

The early years of a mine's operations are the most hazardous. It is at that time newly entering into a competitive market, possibly during a period of fluctuating prices, and its grade and costs have still to be finally established. The hazard of return of capital to the company and to the shareholder is at a very high level. Until the aggregate of income equals the amount invested, income tax adds to the high risk of capital recoupment. Only when the investment has been recouped from income can this additional hazard imposed by taxation payments disappear. But, from that point on, taxation continues as a factor contributing to the reduction of ore reserves, and minimizing the returns expected from high risk-rate mining investment.

The above brief essay merely summarizes the long-standing thoughts of many in the mineral industry; it contains nothing new. But from these thoughts emerge a series of implications in the relation of taxation to national development of the mineral industry. If development is to be our prime concern, as it should be, then full attention should be given to those implications, with the object not only of removing hindrances to, but also of stimulating development.

Perhaps one major implication is that the effect of the income tax code as a whole, over the entire life of a mine, is relatively not so important as the impact of taxation at

different stages, either in exploration or during a mine's history. It is pointless to say that the Australian Act is good because it exempts gold and uranium mines from tax—that is no help to the tin miner. The partial exemption granted under Section 23A to the tin miner is of no help to the lead-zinc miner. Provisions for amortization, excellent though they may be, do not assuage the anxiety of the investor who sees no prospect of getting his money back on a mine which has proved to be marginal. A mine paying tax during its inaugural years whilst settling down is in a very different position from the successful mine of many years standing.

Although the Australian Income Tax Act does appreciate to quite a considerable extent the importance of taking into account the impact of taxation at different stages in a mine's history, a good deal of criticism has been directed at the Act on this score. Such criticism is commonly illustrated by references to the income tax Acts of other countries.

The writer would prefer to discuss the Australian Income Tax Act on its own merits, to examine not only where it is good, but also where its impact on mineral development needs strengthening. Before doing so in later articles, it is as well to summarize those Sections of the Australian Act which refer specifically to the mineral industry—those relating to minerals other than oil are tabulated.

Taxation on Minerals other than Oil

(A) PROSPECTING OR EXPLORATION

Calls Paid by Shareholders to Prospecting Companies

78 (1) (b)

One-third of the calls paid by a shareholder to a mining or prospecting company or syndicate, carrying on mining or prospecting for gold, silver, base metals, rare minerals or oil, as its principal business, are exempt from tax.

Expenditure on Exploration

123AA

Expenditure on exploration or prospecting (other than for gold and petroleum) is an allowable deduction. The deduction may be made from income derived from mining only, and not from other sources of income. Excess of exploration expenditure over mining income in the year incurred may be carried forward and deducted in subsequent years.

Income from Sales of Prospects

23 (p)

Income of a bona fide prospector derived from the assignment of his right to mine for gold or specified minerals or metals is exempt, except to the extent of deductions previously allowed under 123AA. "Prospector" includes individuals, syndicates and companies. (The specified minerals and metals are listed at the end of the tabulation.)

Dividends to Shareholder from Sale of Prospects

44 (2) (a)

The exemption granted under 23 (p) to a company is extended to the shareholder.

(B) OPERATING MINES

Calls Paid by Shareholders in Operating Mines

78 (1) (b)

One-third of the calls paid to a mining or prospecting company or syndicate, carrying on mining or prospecting for gold, silver, base metals, rare minerals, or

oil as its principal business, are exempt from tax.

Amortization in Operating Mines

88

The purchase premium of a mining lease can be written off over the life of a new prospect assigned under 23 (p), or of an old property if the election is not made under 88B (see below).

123AA

Excess of expenditure on exploration or prospecting (other than on gold and petroleum) may be written off under Section 122 (see below).

122

Residual capital expenditure on plant, development, housing and welfare can be written off at a rate determined by dividing the amount either—

- (a) by the number of years estimated life of the mine, or
- (b) by twenty-five, whichever is the less.

122A

Expenditure on plant and development may be written off, alternatively, in the year incurred.

(Note: This section does not include expenditure on housing and welfare.)

122B

Money appropriated for expenditure on plant and development in the next succeeding year may be deducted in the year of income.

123

If the taxpayer so elects, expenditure on plant may not be deducted under Sections 122, 122A or 122B but may be written off at a normal rate of depreciation as for industry in general (Sections 54 and 55).

Total Exemption on Income from Operating Mines

23 (a)

Income from gold and gold-copper mining is exempt.

23D

Income derived by a resident taxpayer from the mining and treatment of uranium ores is exempt. (The exemption terminates in 1965.)

23A

One-fifth of the income on mining a scheduled list of minerals is exempt. (The exemption terminates in 1960.)

The scheduled minerals are listed below. Important minerals excluded: lead, zinc, coal, iron ore.

Income from Sale of Mine

88B

The premium received by the vendor on the sale of a mining lease is exempt if the vendor and buyer so elect (see 88 above).

Dividends from Profits on Operating Mines

44 (2)

The total exemption on income from the production of gold (23 (o)) and uranium (23D) is carried to the shareholder.

The shareholder is granted an exemption in full on dividends paid out of the allowance to the company of one-fifth of income exempted under 23A.

Dividends from Sale of Mine

No Australian provision corresponds to the Canadian partial exemption on dividends paid from profits on the sale of an operating mine.

Minerals Prescribed under Sections 23 (p) and 23A

Asbestos, Bauxite, Chromite, Emery, Fluorspar, Graphite, Ilmenite, Kyanite, Magnesite, Manganese oxides, Mica, Monazite, Pyrite, Quartz crystals (Piezo-electric quality), Radioactive ores, Rutile, Sillimanite, Vermiculite, Zircon. Ores of: Antimony, Arsenic, Beryllium, Bismuth, Cobalt, Columbium, Copper, Lithium, Mercury, Molybdenum, Nickel, Osmiridium, Platinum, Selenium, Strontium, Tantalum, Tellurium, Tin, Tungsten, Vanadium.

Tailing Disposal at Mufulira

Problems of tailing disposal and the methods to be used in the construction of Mufulira's new tailing dam are discussed by Aubrey Finn, concentrator superintendent, Mufulira, in Horizon, the magazine of the Rhodesian Selection Trust Group of Companies, from which this article is abstracted. The lake formed behind the new dam will be more than three miles long and will cover 3,000 acres.

HOW to dispose of the worthless tailing from mining operations is a world-wide problem, a solution to which is sought in many ways according to local conditions of climate and terrain and the size of the project. From some conveniently situated mines, it is possible simply to discharge this waste directly into the sea. In areas of low rainfall it is possible to pump the tailing into a dry river valley, where rapid evaporation facilitates deposition of the solids. In other cases, more elaborate methods of disposal have to be arranged such as the construction of lengthy conduits to suitable sites or the construction of tailing dams to impound vast lakes to the bottom of which the solid material may be deposited, while the clear water may either be decanted and allowed to flow into the river or re-used in the metallurgical process.

Since the tailing is usually without value, the cheapest methods of constructing such dams are normally sought. This almost invariably means using the tailing itself, possibly classified to provide the coarser fractions, for forming the outer portion of the wall of the dam, whether this is built across a valley or on the nearby slopes. Many methods of dam construction are employed, each method depending on the nature of the tailing, the ground on which the dam is built, the climate, the skill of the labour available and many other factors. Probably the simplest method is where the tailing flows from a high part of the country into a depression in which the wall of the dam is progressively raised by manually shovelling up a small bank of the settled solids.

From this simple method, more and more complex techniques for providing a shovelled bank and the more complicated systems of multiple walls and paddocks have been evolved. The latter may call for the use of settling cones, mechanical classifiers, bulldozers, draglines and other devices.

One efficient method, pioneered mainly by Mr. Max Goldick, concentrator superintendent at Roan Antelope, and now used in many parts of the world, employs a simple hydro-cyclone through which the tailing pulp is pumped. Centrifugal forces drive the coarser particles to the outer wall of the cyclone, down which they flow to issue at the apex in the form of a fairly dense, granular mud with relatively little water. This builds up into a conical pile, and, by using a number of cyclones and moving them at frequent intervals, a continuous ridge may be formed. Large dams may require great numbers of these cyclones and more than 300 have been employed at a time. The fine tailing fractions, together with the greater part of the water, discharge from the top of the cyclone and are normally led into the dam formed by the deposited coarse particles.

Previous Experience at Mufulira

Earlier experience has guided the planning of the new dam at Mufulira and many schemes and sites within a ten-mile radius of the mine were considered before the locality and method of construction of the large new dam were decided upon.

Until 1952, all the dam walls at Mufulira had been built across valleys or small depressions, both by the primitive

shovelled bank method and by discharge of the tailing through openings about 20 ft. apart in a pipe or launder running on supports just above the crest of the wall. As the crest rose, the launder was raised and moved inwards to deposit further banks. No. 7 dam, in use until 1952, was built across the Mufulira Stream by raising parallel banks about 300 ft. apart by manual shovelling and allowing the tailing to settle between them. From these settled solids, additional banks were built, while the tailing not required for building was discharged into the impounded lake. This dam, the largest built at Mufulira up to that time, collapsed in 1952 and in consequence dams Nos. 8 and 9 were built, not in a low-lying valley, but well up on the sides of the Mufulira Valley.

These dams were made by manually shovelling three 2 ft. high banks, the outer one on the perimeter crest and the other two parallel to it and some 150 ft. and 400 ft. respectively from it. The tailing delivered into the paddocks thus formed is allowed to settle. From the solids deposited the banks are built up by shovelling and the process repeated. The resultant wall is on two levels, that between the outer and centre banks being kept about 5 ft. above the inner level to provide additional safety should the pool within the dam rise too high in heavy rain storms.

The areas of these two dams are around 400 and 700 acres respectively and their banks are being raised by about 1 ft. per month. As the total perimeter is more than seven miles, a labour force of five operators and about 160 labourers is required to keep the bank building ahead of filling, the dams being used alternatively as called for by operating conditions.

Design Considerations

Were the period over which these two dams could be used long enough, the additional expense of installing some classifying devices such as hydro-cyclones and the necessary piping might be justified. The life of the dams, at the present rate of production, is, however, unlikely to be extended beyond about 1970 and with the 50 per cent increase in production resulting from the working of the western extension of the mine, the current dams will not last beyond about 1967.

Because of this limited life of the existing facilities, the need for the planning and construction of additional disposal sites became urgent if production were to be maintained at the regular rate of 600,000 tons of ore a month.

Despite the fact that No. 7 dam across the Mufulira Stream collapsed, it was decided to build the new No. 10 dam across the valley of the Butondo Stream, a tributary of the Mufulira Stream. This decision was made possible by the relatively new science of soil mechanics. Besides enabling the properties of the materials to be used to be examined, this also enables engineers to predict with accuracy how the wall is likely to behave and to determine the limiting slopes, heights and other dimensions that may be worked to.

At the new dam, which will vary in height from ground level at the sides to 110 ft. at the middle, the discharged mill tailing will settle and compact initially against the upstream

face of the wall, gradually advancing into the lake which will have an ultimate capacity of about 170,000,000 tons. If current investigations into the possibility of eventually raising the height of the main wall show that this is practicable, together with the construction of two other small walls across low-lying necks at the side of the lake, this total may be substantially increased. F. E. Kanthack and Partners, engineering consultants, are supervising the civil engineering work.

Most of the wall will consist of the coarse fraction of the tailing produced in the concentrator, classified in cyclones as at Roan and placed as a normal operating procedure. Tailing at the rate of 300,000 tons a month will be required for this purpose. A slope of 34 deg. from the horizontal will be the maximum for the downstream face, compared with 40 deg. normally employed at Mufulira in the past. To prevent undue erosion of this face during storms, it will be made in a series of benches, about 20 ft. high, each with its own system of drainage and an extensive system of crushed stone filters will be laid before starting the deposition of the tailing to allow water percolating through the lower part of the wall to drain away.

Whereas the "upstream" method of dam construction has been used at Roan and elsewhere, the "downstream" method will be used for Mufulira No. 10. In the former, the coarse sand wall is built progressively upon the fine slime deposited during each preceding operation, but in the latter method this feature is avoided and all the coarse sand is

built up on previous layers of coarse sand. This avoids what might be a serious defect in a high wall, but the considerable amount of extra work involved is regarded as being worth while from the safety viewpoint.

A toe-wall of waste rock from mine operations will be placed at the downstream foot of the wall to provide a massive abutment to inhibit any incipient "slips" that may tend to occur at the base which is 1,000 ft. wide.

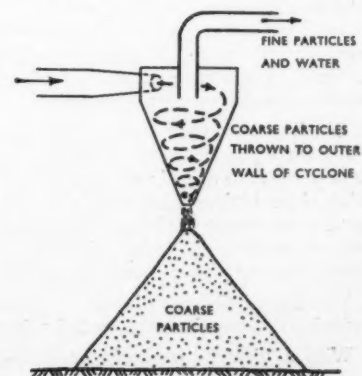
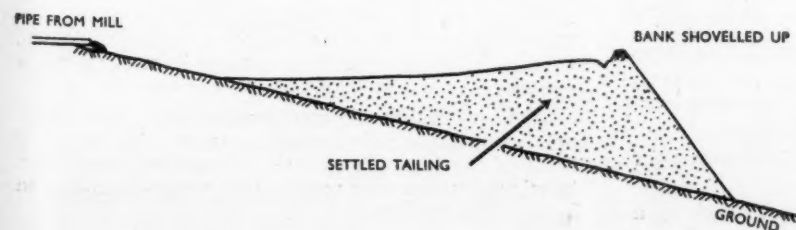
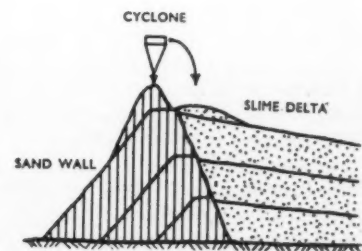
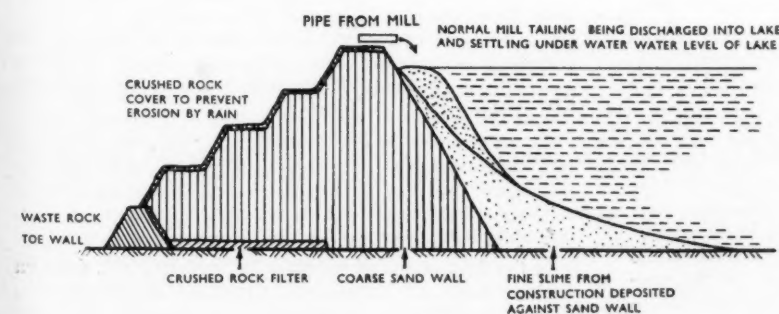
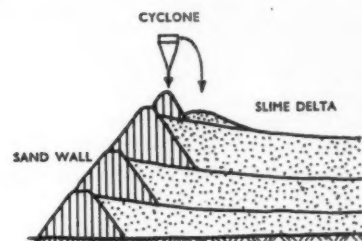
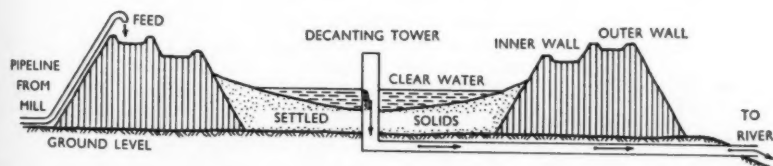
Clear water from the lake will be discharged through a spillway in a neck of land about three miles upstream from the wall and ducted across into the valley of the Mufulira Stream. By putting this discharge point away from the site of delivery of tailing to the dam, the clarity of the upstream section of the lake will be assured.

Adequate freeboard will be incorporated in all the walls to cope with floodwater.

The cost of erecting the dam may be equal to the cost of labour necessary to operate the existing dams for ten years, but, once built, the annual operating cost will be negligible. The life of the dam will be at least 25 years, longer if higher walls prove possible.

Completion of the dam is planned to coincide with the commissioning of the new plant to treat the Mufulira West ore, so that from 1962 onwards most of the headaches associated with tailing disposal will disappear. To provide for any emergency entailing interruption of operation at No. 10 dam, Nos. 8 and 9 will be kept in a state of readiness.

Construction Data on the new Mufulira Tailings Dam



EXTRACTION OF URANIUM AND THORIUM

WORK on the extraction of metals undertaken by the National Chemical Laboratory in 1958 has included research of interest to the United Kingdom Atomic Energy Authority and the separation of the rare earths by ion-exchangers. Some of the oxides and compounds of the rare earth metals have been supplied to the Atomic Energy Research Establishment at Harwell and to other departments for research projects.

Methods for the extraction and recovery of uranium from a variety of ores have been studied. In this connection investigations into the mechanism of silica sorption from acid solutions by anion-exchangers have shown that the poisoning effect is not an ion-exchange process. It was found that the extent of silica sorption depended on the concentration of the low polymeric forms of silicic acid, not on the total silica concentration and increases with increases of pH over the range 1.5-4.0. The anionic form of the resin has a marked effect on the extent of silica adsorption which at pH 1.8 decreases in the order $\text{SO}_4 > \text{Cl} > \text{NO}_3 > \text{ClO}_4$. No silica sorption took place with the ClO_4 form at this pH. At pH 3.5, the sorption by all forms increased although the differences between SO_4 , Cl and NO_3 forms were less marked.

Natural leaching, where, in the case of certain pyritic ores, the FeS_2 in the presence of air and water gives rise to H_2SO_4 , is being studied with a number of different uranium-bearing ores. Tests are being carried out in specially constructed P.V.C. columns having a sump at the base for collecting the effluent and with the ore supported on a perforated plate. Water is added periodically to the top of the column and the effluent run off for analysis. Pyrite is added to ores which contain little or no pyrite.

The general types of reaction which occur can be represented as follows:—

1. $2\text{FeS}_2 + 2\text{H}_2\text{O} + 7\text{O}_2 \rightarrow 2\text{FeSO}_4 + 2\text{H}_2\text{SO}_4$.
- 2a. $2\text{H}_2\text{SO}_4 + 4\text{FeSO}_4 + \text{O}_2 \rightarrow 2\text{Fe}(\text{SO}_4)_3 + 2\text{H}_2\text{O}$.
- 2b. $\text{Fe}_2(\text{SO}_4)_3 + 6\text{H}_2\text{O} \rightarrow 2\text{Fe}(\text{OH})_3 + 3\text{H}_2\text{SO}_4$.

Under the conditions used at the laboratory, uranium extractions of 60-80 per cent have been obtained in 18 weeks.

In connection with the solvent extraction of uranium a number of commercially available alcohols (often needed to prevent third-phase formation) have been compared with respect to their solubility losses.

An interesting possibility studied during the year has been that of direct solvent extraction from uranium ore pulps. The main problem has been that once the pulp and the organic phase have been thoroughly mixed together, they do not readily disengage. The uranium present in the leached pulps may be extracted by a limited contact between the phases and a disc contactor has been designed for this purpose. The solvent used is a 0.1M solution of di (2-ethylhexyl) hydrogen phosphate in kerosene and the loaded solvent is stripped of uranium in the normal manner. Preliminary work has begun on a multi-stage unit.

Detailed tests have been carried out with the branched chain amine, Primene JM-t to study the use of certain amines in preference to organic phosphates in the solvent extraction of thorium. This amine was able to extract thorium selectively from a solution containing a very large excess of $\text{Fe}_2(\text{SO}_4)_3$ without previous reduction of the iron to the ferrous state. Extraction was also constant over a wide pH range.

Normal HNO_3 was found to be a suitable agent for stripping thorium from the loaded solvent.

With a view to producing reactor-grade thorium by a

solvent extraction procedure an investigation was begun into the possibility of selectively stripping impurities from the loaded solvent. Preliminary experiments with HCl and H_2SO_4 varying in concentration between 0.01N and 0.1N indicated that neither of these reagents was suitable. A much improved result was obtained when sulphurous acid was used. In a single contact experiment 41.5 per cent of the total impurities was transferred to the aqueous phase but successive contacts with sulphurous acid failed to give a final product of the desired degree of purity. This also applied to an attempt to disrupt complexed material by contacting loaded solvent with an impurity strip-solution consisting of thorium sulphate in sulphuric acid. By combining the reducing action (on iron) of sulphurous acid with displacement of complexed iron and other metals by thorium a final product of 98.7 per cent purity was obtained, but this is under the required grade for use in reactors. The A.E.A.'s interest in thorium having lessened, further efforts in this direction were discontinued.

Other Investigations

Investigations into ion-exchange methods for the recovery of gold and other metals from solution as cyanide complexes have continued. These have included the preparation reproducibly of weak-base resins containing a pre-selected percentage of randomly distributed strong-base groups, in which some difficulty was encountered, and loading and elution experiments carried out under somewhat more realistic conditions in order to obtain some assessment of the economic factors governing the operation and application of the process.

Chemical methods for the extraction and concentration of beryllium from low grade ores and flotation concentrates are being studied with the object of obtaining an economic process for utilising these materials as a source of beryllium.

In connection with the separation of rare earths, laboratory scale work on the mixed-loading technique, using EDTA and TRILO has been completed. Other research has included the distribution of the light earths between solutions of their complexes and the cation exchange resin Zeo-Karb 225, the examination of eluants for the gadolinium-yttrium separation and the purification of ytterbium.

Larger scale testing of the beneficiation technique described in Chemistry Research 1957 using a light-earth concentrate was carried out. Lanthanum, praseodymium and neodymium were isolated at a purity of 99 per cent, but the gadolinium-samarium separation was poor.

In the field of analytical research, work has been done on minute traces of impurities in metals, the development of techniques for the determination of uranium and other metals in radioactive ores, spectrometry and micro-analysis. Concerning the separation of the rare-earth metals on cellulose phosphate investigations were carried out to determine whether the adsorption characteristics of different rare earths varied sufficiently for the development of a separation technique which might be useful in the analysis of rare earth mixtures. Other applications of modified cellulose included its use in detecting minute traces of metals.

Numerous radiometric measurements have been carried out in connection with corrosion studies using tracers, a study of the metabolism of micro-organisms, purification techniques such as zone melting, and chromatographic and ion-exchange separations.

MINING MISCELLANY

Two local diamond mining firms have been set up in the Simbaru Chiefdom in the Kenema District, Sierra Leone. One is the Lebafric Diamond Mining Co., 51 per cent of whose copper shares are held by Sierra Leoneans and the balance by Lebanese. This company has for the past year been prospecting near Boajibu under an exclusive prospecting licence, and claims to have found some diamonds already. A successful meeting was recently held with the Tribal Authority in connection with a mining licence. The other company is the Minerals Research (Sierra Leone) Ltd., and is made up of Sierra Leoneans and other nationals. The company, which is registered in Sierra Leone, has its parent body in the U.K.

White Pine Copper Co., a wholly-owned subsidiary of Copper Range Co., has reported a new copper ore deposit on its property, about 17 miles southwest of Ontonagon, Michigan. The extent of the deposit has not yet been disclosed.

A considerable quantity of Canadian coal will be exported from British Columbia and Alberta to Japan next year. Early in 1959 Japan imported 100,000 tons of coking coal and 60,000 tons of anthracite from Western Canada for testing in Japanese steel plants. The tests proved very satisfactory, and orders for regular shipments, expected to reach 1,000,000 tons annually, are to be placed.

The Eire Minister for Industry and Commerce has announced from Dublin that he is prepared to consider applications for financial grants to provide technical assistance for private mineral exploration. The conditions for the grants are that the project must be approved by the Minister. The grant will be up to one-half of the cost, and total expenditure must not be less than £1,000. Grants will not be made for development machinery.

Eti Bank officials announce that plans have been made to open up the Haliköy mercury deposit, in Ödemiş County of Izmir Province, where Mineral Research and Exploration Institute of Turkey has proved a deposit of up to 80,000 tons of cinnabar.

According to recent Press reports from Colombia, a new zinc smelting Bogota in the near future. This plant, plant is scheduled to begin operating in owned by Roberto Jaramillio Ferro, will produce 5 tons of refined zinc daily. High-grade ore (70 per cent zinc, 0.6 per cent cadmium) is found at Junin near Bogota; however, the supply is not large enough to meet the entire smelter requirements. Other prospective sources are: the Fontino gold mine in Antioquia, where zinc has been discarded as a by-product of gold mining, and the Colurano uranium concession at California, Santander.

Sumitomo, the large Japanese industrial and trading group, plans to begin production of nuclear fuel elements, and has reached an agreement with Sylvania Corning on rights to its

induction technique of processing uranium oxide. Sumitomo are reported to have a previous agreement with Degussa on natural uranium refining, and are developing a method, said to be unique, for making natural "U" bars with high temperature and gamma rays.

A new organization, Industrial Safety (Personal Equipment) Manufacturers' Association, has been formed by many of the leading manufacturers of industrial safety equipment in the U.K. in order to try to reduce British industrial accidents. The Association hopes to work in close liaison with government departments, Trade Unions, medical and safety authorities, etc., and those wishing to be kept informed of the Association's activities are invited to write to the chairman.

New deposits of uranium have been reported from Czechoslovakia, these being situated in eastern Bohemia and to the north and east of Moravia, at Jihlava, Havlickuv Brod, Pelhrimov, Velke Mezirici and Lazne Jesenik. While their size has not been made public, it may be noted that two special State enterprises, Havlickuv Brod and Lazne Jesenik, have been created specially for their exploitation, instead of Jachymov, the existing State enterprise handling the matter.

A recent Chinese Agency report from Hanoi states the Cao Bang tin mine, in the northern part of North Vietnam, of production for 1959 by end-October, has already achieved its planned target and that present annual output from the mine is over 2,000 tons. This compares with a peak output of only 340 tons under its former management.

A Ministry of Economic Affairs survey team in Formosa estimates that the country's remaining coal deposits amount to 420,000,000 tonnes.

From Turkey it is reported that annual production of coal has reached 6,555,000 tonnes, and should reach 7,000,000 tonnes. There is an exportable surplus of about 400,000 tons. Lignite production totals 2,600,000 tonnes annually.

Turkey plans to extend further the Karabük iron and steel plants. These extensions will enable iron ore production to go up from 500,000 tons to 1,000,000 tons annually, and steel from 148,000 tons to 600,000 tons.

Belgian coal output declined during 1959 by about 17 per cent, and is now thought to amount to about 22,500,000 tons. Stocks at the pits increased by 17,960 tons in October, and now amount to about 7,800,000 tons compared with 6,600,000 tons at the same time last year.

According to statistics released by the Liberia Mining Co., about 1,299,000 tons of iron ore was produced by the company during the first half of 1959. Average iron content was 66.37 per cent for direct shipping ore and 65.85 per cent for concentrate. Production for the

second half of 1959 is estimated at 1,300,000 tons, which indicates a record annual production of about 2,600,000 tons.

A delegation from the Scientific Instrument Manufacturers' Association of Great Britain left London recently for Moscow at the invitation of the Russian All-Union Chamber of Commerce, to discuss the possibilities of an exhibition of British scientific instruments in Moscow next summer. This exhibition will be the first independent exhibition of a general nature ever to be held in Moscow.

PERSONAL

Mr. C. J. Beavis has been appointed by Birlec-Efco (Melting) Ltd., to take charge of all Birleco's smelting activities.

Edgar Allen and Co. Ltd., announce the retirement of Mr. H. D. Boyd a director of the company. Mr. F. S. Marsden has been appointed a Transport and Traffic Manager of the company, in succession to Mr. C. Shaw, who recently retired.

COMING EVENTS

The following list of fixtures has been issued by the Institution of Mining Engineers:

Manchester Geological and Mining Society at Wigan Mining and Technical College, December 10, 4 p.m. "Shaft Sinking at Parkside" by Mr. C. McLauchlan.

Midland Counties Institution of Engineers at Mansfield Woodhouse Mines Rescue Station on December 16, 6.30 p.m. "Purchasing and Stores Department of the National Coal Board" by J. M. Grammer.

Midland Institute of Mining Engineers at Danum Hotel, Doncaster, December 10, 2.30 p.m. "Some thoughts on the possible application of Continental methods of thick-seam mining to the Barnsley seam in Yorkshire", by A. Brookes and P. G. Tregelles. Royal Victoria Hotel, Sheffield, on January 7, 1960, 2.30 p.m. "Layering of fire-damp in longwall workings" by E. J. Raine.

Mining Institute of Scotland at the Royal College of Science and Technology, Glasgow, December 4, 5.15 p.m. Junior Meeting: "High Speed Tunneling" film introduced by R. G. Watt.

Southern Counties Institute of Mining Engineers, 3 Grosvenor Crescent, London, S.W.1, December 11, 3.30 p.m. "The estimation and reduction of the aerodynamic resistance of mine shafts" by J. G. Bromilow.

North of England Institute of Mining and Mechanical Engineers, the Institute, Neville Hall, Newcastle upon Tyne, December 12, 2.30 p.m. Annual General Meeting and presidential address.

North Staffordshire Institute of Mining Engineers, North Staffs., Technical College, Stoke-on-Trent, December 14, 4.30 p.m. "A typical firedamp-extraction plant in the North Staffordshire Area" by J. Sutton.

Machinery and Equipment

New Design of Mine Pump

The John Clark pump is a new design of pump of the mixed flow type which excels in its field. It is marketed by a new company, Messrs. John Clark Pumps Ltd., Glasgow, who report that U.K. sales are proceeding satisfactorily and that enquiries have been received from potential overseas markets. Designed by the late Mr. John Clark, managing director of Riverside Engineering Co., this new pump is meant in the first instance for the dewatering of in-by workings in mines, but its characteristics make it very suitable for general application in mining, civil and chemical engineering. It was featured at The Mining Machinery Exhibition at Olympia in July.

Two of the most outstanding features are the ability of the pump to snore, and an exceptionally high suction lift. A prototype on test ran continuously for well over 3,000 hours showing a suction lift of 20 ft. in water at 70 to 72 deg. F., and the production model has fulfilled all expectations. Possessing a $5\frac{1}{2}$ h.p. motor, the pump discharges more than 80 g.p.m. against a head of 100 ft., with suction and delivery end couplings of 2½ in. in dia.

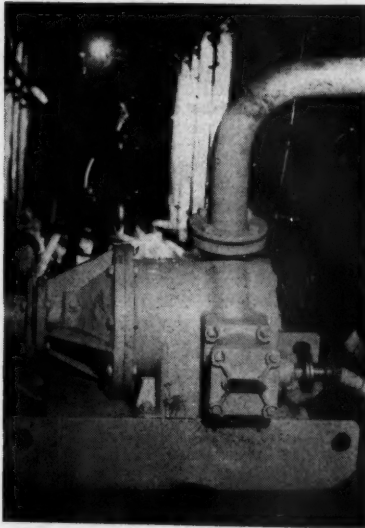
The pump consists of a cone-shaped impeller rotating at 2,980 rotations per min. from which the water is discharged into a diffuser. In this diffuser the water is gradually turned into the axial direction to flow through an annulus around the motor housing. Some of these features are protected by patent. The John Clark pump is of a compact and robust design easily panelled and well able to stand up to the roughest usage. No rotating parts are exposed. The flow of water around the motor casing provides a considerable degree of cooling preventing motor heat from being dissipated into the surrounding air, an important point. The pump is flameproof to B.S.S. 229.

REPAIR SYSTEM FOR CONVEYER BELTS

A new technique and a new machine developed by Stenor Ltd., a member of the Firth Cleveland Group, reduces the time required for a small vulcanized repair to a conveyor belt to less than 30 minutes. It is claimed that this repair will be absolutely flush with the cover, and as strong as the rest of the belt.

The Stenor Belt repair kit consists of a Weldbelt vulcanizer, and a set of tools and accessories neatly packed in a carrying case. Repairs can be carried out by one man, and the system is particularly recommended when the belt is operating outside, or in damp or arduous conditions. The Stenor system makes possible a much simpler method of repairing damage, even holes right through the belt, and of repairing the edges of the belt.

The basis of the Stenor system is a re-designed model of the Weldbelt vulcanizer, which has several features which make it of particular interest to conveyor maintenance engineers. The



A John Clark pump being installed in a Scottish colliery

new Weldbelt can be handled by one man. The machine is supplied either unsupported for attachment to a bench, or on a movable stand, or with fittings for fixing to a girder.

The heating units of the new Weldbelt have been completely re-designed. Instead of being a 10 in. x 6 in. rectangle, the effective curing area is now enlarged to an 8 in. x 8 in. square. To each heating unit has been added an 11 in. square base plate which performs a most important function when large repairs are being made. When a repair has to be carried through by stepping the joint, the extended base plate effectively prevents set-up occurring in adjacent and previously cured areas. The new heating units are streamlined in appearance and the base plates slightly chamfered.

Edging bars are a new feature of the machine which allow repairs to be carried out to the edge of the belt without "spewing." Three bars are supplied with the Weldbelt, giving between them a choice of six belt thicknesses from 2 to 7 plies. Adjusting screws enable side pressure to be exerted along the edge of the belt. Curing time is reduced to an average of 10 minutes.

In order to make the best use of the Weldbelt machine, Stenor have developed a new procedure for belt repairs and a range of tools and accessories which will enable any repair to be carried out by one man after one or two demonstrations.

Briefly, the procedure is (a) to cut away the damaged cover; (b) to cut away the damaged plies of duck in steps, so that the area of duck removed becomes progressively smaller with each ply; (c) to insert new patches of duck, of increasing size as the plies are built

up; (d) to remove all damp; (e) insert patches of rubber for the cover; (f) cure in the Weldbelt.

RESONANCE SCREENS IN U.K.

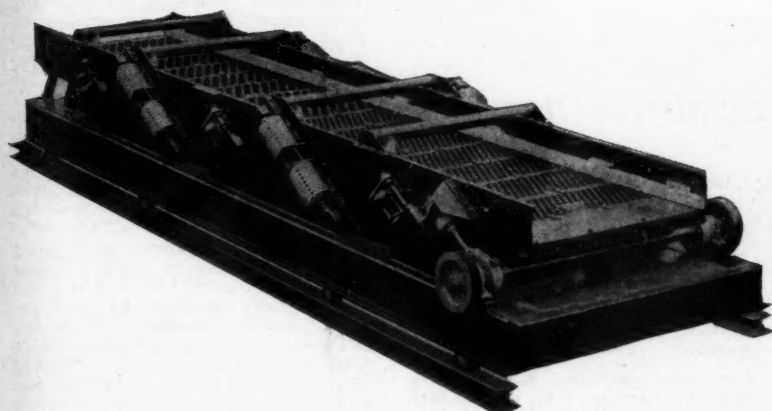
Intended for the screening of all types of bulk materials, which, in some instances, contained a high proportion of moisture, particularly where limited head-room demands a horizontal layout and where the transmission of vibrations to supports is to be avoided, resonance screens are now being manufactured in Britain under licence from Germany.

After being made for a number of years in Germany by Pintsch Bamag, the Bamag Resonance Screens now being manufactured under licence by Edgar Allen and Co. Ltd., of Sheffield. Although the manufacture of resonance screens in Britain is not a new departure (at least two other German types are already being made here under licence), the Bamag screen incorporates a number of interesting features of its own.

Resonance conditions are achieved by the choice of suitable springs and damping elements, the use of rubber buffers to store some energy at the end of the stroke being an important factor.

The screens frame is given an initial displacement by the driving mechanism which consists of a pulley-driven shaft mounted on pedestal bearings and carrying either one or two connecting rods, according to the size and width of screen, coupled to eccentrics in the shaft and attached to the screen by flexible rubber mountings. The plane of displacement of the screen frame is controlled by wooden laths secured to the base frame and its arc of travel is limited by rubber pads mounted in triangular blocks also fixed to the base frame. These pads absorb and release energy at the end of each stroke. Slight damping losses which occur are restored to the vibrating mass by the drive, the displacement of the connecting rod end being approximately in phase with the vibrations of the screen. The frequency and amplitude of the vibrations are therefore maintained at their pre-set values and are insensitive to any fluctuations that may occur in the load or the frequency of current supply to the drive. On one of the models (R.1) a laminated type of rubber buffer is used in conjunction with the more usual type S buffer.

The high accelerative forces produced by the form of vibration are claimed to give particularly thorough particle separation at frequencies between 500 and 1,000 vibrations per minute and with strokes normally between ¼ in. and 1½ in. The machine can be equipped with any angle of throw between 60 deg. and 30 deg. Since the only function of the drive, once the machine is started, is to replenish damping losses, the horsepower requirement is small and maintenance is reduced by simple yet robust construction, the only components requiring regular replacement being the rubber vibration pads which have an average life of 2-3 years. The efficient



Resonance Screen Type "R.1."

balancing of the two vibrating masses and the use of vibration mountings give quiet running and prevent the transmission of shock loads to the supporting structure, which can be designed to support a static load slightly greater than the weight of the machine.

Two models of the Bamag Resonance Screen are being made: Type S to suit all capacities and Type R.1 to suit high capacities.

A NEW DRILL

The Reich Drill division of The Consolidated Pneumatic Tool Co. Ltd., has announced the introduction of a model 155 down-the-hole, self-propelled drill for operations where holes in the 4½-5 in. dia. range are required to depths of down to 250 ft.

A particular feature of the new drill is the extensive use made of hydraulics, not only for driving the drill rod rotation motor, but also for such duties as providing the necessary degree of thrust for the rod string, for positioning the drilling mast, hoisting the rod string, propelling the rig around the drilling site and for the dust extraction unit.

The hydraulic system is powered by a Ford 3 cylinder diesel engine, directly connected to a hydraulic pump, the compressed air required for operation of the down-the-hole hammer being provided by a CP. 365-RO-2 compressor which delivers 365 c.f.m. at 100 p.s.i., this latter unit being towed behind the drill on suitable terrain.

The rods used are 10 ft. lengths of Reichdrill 3½ in. o.d. hollow sections which are fitted with screw joints of specially alloyed steel to meet the high torque conditions. Two sizes of down-the-hole air operated hammers are available and two sizes of bit can be supplied with each hammer. Bit sizes are 4½ in., 4¼ in. and 5 in. The design of the hammers is such that a high velocity blast of air, created by the air leaving the exhaust ports, is passed up between the hammer and the wall of the hole to clear the chippings from the hole. All drilling and propelling controls are housed in a steel panel control cabinet and have finger tip operation.

Penetration rates in carboniferous limestone have been shown to average 45 f.p.h., whilst the average overall rate of drilling for an 8 hrs. shift was 30 ft. per hr. including setting up, rod change and travel time from hole to hole. This rate is some three times faster than

the best average results normal from down-the-hole rigs in the U.K.

TESTING FLAME SAFETY LAMPS

A simple apparatus to test flame safety lamps for faults has been devised by Mr. G. H. Vardy and is in regular use at Welbeck Colliery, East Midlands Division, where Mr. Vardy is head lampman.

Usually routine lamproom tests on flame lamps involve either a visual examination or the lampman blowing on the glass to see whether this has any effect on the flame. The Welbeck apparatus is designed to place the latter method on a more scientific basis.

It consists of a small turntable to which a lamp may be quickly fitted by means of a baffle clamp. The clamp is spring-loaded to give rapid operation and is integral with the turntable. The turntable and clamp are machined to fit the particular type of lamp in use at the colliery.

The turntable is mounted on a ball race which is integral with a stand fabricated from ½ in. plate. Mounted on this stand are three nozzles connected with a supply of compressed air. One nozzle actuates the turntable which is fitted with vanes for this purpose. The other nozzles are angled to give an upward and downward jet of air on to the lamp glass when the lamp is clamped in position, and they are so located that the upswept air jet strikes the glass a quarter of the way down the glass from the top, and the downswept jet a similar distance from the bottom. Both testing jets are directed against the motion of the turntable to give adequate air pressure behind the lamp standards as they approach.

Testing is carried out by placing each lamp in turn in the clamp and rotating it several times with the turntable. Each test is made with a low air velocity, a small flame on the lamp under test, and with the turntable rotating slowly.

The types of fault which can be detected by this apparatus include faulty asbestos or compound washers; chipped glasses across the wall of the glass at whatever angle they occur; grit, glass splinters and dust accumulations underneath the glass or washers; dented or distorted glass plates and gauze seatings; lamp middle parts out of parallel, or the glass itself off the permitted tolerances; glasses that appear to be sufficiently tight but do not seat properly; badly fitting vessels; and perished or absent rubber washers under the glass plates of officials' relighter lamps.

The C.P. 155 Reich Drill



Metals and Minerals

De Beers Can Make Synthetic Diamonds

In so far as there had been no previous indication that De Beers Consolidated was working on the production of synthetic diamonds, Mr. Harry Oppenheimer's announcement in Johannesburg that the company had developed a method of making synthetic industrials of the same type as those manufactured by the U.S. General Electric Co. was unexpected. Yet it would have been surprising that De Beers, with its unrivalled knowledge of diamonds and the unique research facilities at its disposal, had been content to leave the development of this new field to existing or potential competitors. After all, there could be no more effective answer to the challenge of synthetics than for the diamond industry to be in a position to produce them itself.

The announcement follows closely upon the release by General Electric of the first detailed description of its techniques, but Mr. Oppenheimer said that De Beers was not in possession of sufficient details of that process to be certain whether its own process was the same or whether a new approach to the problem had been found.

Dr. J. F. H. Custers, Director of Research at the De Beers Adamant Laboratory in Johannesburg, states that the South African discovery was the climax to a programme initiated in 1955. The research team had, of course, an extensive knowledge of the structure

and character of the natural diamond gained in years of research at the Diamond Research Laboratory itself, and it has also studied the General Electric product. Broadly, it was known that diamond material could be synthesised out of an unknown starting material if appropriate conditions of pressure and temperature could be developed and maintained.

The new laboratory building was completed in October, 1956, and the first step in the long series of experiments was the design and construction of a pressure chamber which could withstand pressure and contain temperatures at the high levels necessary for diamond synthesis. Experiments on such a chamber began in May, 1957, and in September the following year the conditions necessary were attained, resulting in the production of the company's first synthetic diamond. X-ray tests gave conclusive proof of its character.

The first particle of synthetic diamond produced in South Africa measured 0.4 mm. x 0.25 mm., and it was made up of six equal-sized particles closely cemented together.

At this stage, it was felt that patent protection should be sought for the results so far achieved, and on November 7, 1958, provisional applications for patent rights were lodged. To perfect the procedure which would allow the

final patent application to be lodged within a year, the pressure chamber was improved to yield consistent results and to maintain the critical condition of pressure and heat required for synthesis. The starting material had to be varied for better yield values and thousands of experiments were carried out during this period. It was only on September 16 this year that the continuous production of synthetic diamond was established. Applications for a patent have now been filed by De Beers throughout the world.

Subsequent experiments have shown that different types of material can be produced, but it is clear that synthesis, at this stage, can only be practically applied to the manufacture of abrasive grit for use in resinoid-bonded grinding wheels. It is only in this field that synthetic diamonds have so far been able to compete. The Adamant Laboratory has not been able to manufacture other types of industrial diamonds, and there is no question of the manufacture of gem diamonds. Some of the diamonds produced by the company have been bonded in grinding wheels, and tests of their grinding efficiency are now being carried out.

The whole manufacturing process is still in the laboratory stage, but Mr. Oppenheimer expressed confidence that it would be technically and economically possible for the company to proceed to manufacture on a commercial scale if it was found desirable to do so. Its decision in this matter will be taken in close co-operation with the Belgian Congo diamond mining company, the Societe Minière du Bécéka, which produces the great majority of the world's supply of the quality of natural diamond with which the new synthetic is in competition, as well as all the other qualities of industrials for which synthetics provide no substitute.

Mr. Oppenheimer also expressed the opinion that the new discovery would further encourage research work and that the effect would ultimately be a greatly expanded market in which both the natural and the synthetic product will find their place.

Having regard to the immense technical and financial resources of De Beers, it can safely be predicted that if and when the decision is taken to proceed with commercial development of this remarkable scientific achievement, the company will rapidly be established in the forefront of the new synthetic industry. Meanwhile, its work in the synthetic field must doubtless be contributing to a still greater knowledge of the natural product and the qualities influencing its performance in the grinding field.

WOLFRAM'S RECOVERY CONTINUES

A few days ago a hardening of wolfram prices became discernible, representing the first reversal of the downward trend from the peak of around 165s. reached in September last. During the past week the upward pressure in wolfram ore shipment prices has continued. On Tuesday London quotations ranged from 133s. to 138s. per 1 ton unit c.i.f. Europe, which compares with 120s.-125s. on November 10. On the following day, the upward movement gathered momentum and prices closed at 138s.-143s. Some of the business reported is for shipment early next year.

The improved tone of the market stems in large part from the firmer atti-

LONDON METAL AND ORE PRICES, NOV. 19, 1959

METAL PRICES

Aluminium, 99.5%, £180 per ton	Manganese Metal (96%/98%) £245/£250
Antimony—	Magnesium, 2s. 0d./2s. 3d. lb.
English (99%) delivered, 10 cwt. and over £190	Nickel, 99.5% (home trade) £600 per ton
per ton	Osmium, £21/£23 oz. nom.
Arsenic, £400 per ton	Osmiridium, nom.
Bismuth (min. 1 ton lots) 16s. lb. nom.	Palladium, £8 12s. 6d.
Cadmium 9s. 6d. lb.	Platinum U.K. and Empire Refined £28 10s. oz.
Cerium (99%) net, £16 0s. lb. delivered U.K.	Imported £27½/£27¾
Chromium, Cr. 99% 6s. 11d./7s. 4d. lb.	Quicksilver, £72 ex-warehouse
Cobalt, 14s. lb.	Rhodium, £41/£45 oz.
Germanium, 99.99%, Ge. kilo lots 2s. 5d. per gram	Ruthenium, £18/£20 oz. nom.
Gold, 250s. 24d.	Selenium, 50s. 0d. per lb.
Iridium, £23/£25 oz. nom.	Silver, 80½d. f. oz. spot and 80d. f'd
Lanthanum (98%/99%) 15s. per gram.	Tellurium, 18s. lb.

ORES AND OXIDES

Antimony Ore (60%) basis	19s. 6d./20s. 6d. per unit, c.i.f.
Beryl (min. 10 per cent BeO)	220s./230s. per 1. ton unit BeO
Bismuth	65% 8s. 6d. lb. c.i.f.
18/20% 1s. 3d. lb. c.i.f.	
Chrome Ore—	
Rhodesian Metallurgical (semifabril) 48%	(Ratio 3 : 1) £15 15s. 0d. per ton c.i.f.
" Hard Lump 45%	(Ratio 3 : 1) £15 10s. 0d. per ton c.i.f.
" Refractory 40% .. .. .	.. .. . £11 0s. 0d. per ton c.i.f.
" Smalls 44%	(Ratio 3 : 1) £14 0s. 0d. per ton c.i.f.
Baluchistan 48%	(Ratio 3 : 1) £11 15s. 0d. per ton f.o.b.
Columbite, Nigerian quality, basis 70% combined pentoxides (Ratio 10 : 1).	Nb ₂ O ₅ :Ta ₂ O ₅ 170s./180s. per 1. ton unit c.i.f.
Fluorspar—	
Acid Grade, Flotated Material .. .. .	.. .. . £22 13s. 3d. per ton ex. works
Metallurgical (75/80% CaF ₂) .. .. .	.. .. . 156s. 0d. ex. works
Lithium Ore—	
Petaltite min. 34% Li ₂ O .. .. .	.. .. . 40s. 0d./45s. 0d. per unit f.o.b. Beira
Lepidolite min. 34% Li ₂ O .. .. .	.. .. . 40s. 0d./45s. 0d. per unit f.o.b. Beira
Amblygonite basis 7% Li ₂ O .. .. .	.. .. . £25 0s. per ton f.o.b. Beira
Magnesite, ground calcined .. .. .	.. .. . £28 0s./£30 0s. d/d
Magnesite Raw (ground) .. .. .	.. .. . £21 0s./£23 0s. d/d
Manganese Ore Indian—	
Europe (46%-48%) basis 67s. 6d. freight .. .. .	.. .. . 73d./75d. c.i.f. nom.
Manganese Ore (43%-45%) .. .. .	.. .. . 69d./71d. c.i.f. nom.
Manganese Ore (38%-40%) .. .. .	.. .. . nom.
Molybdenite (85%) basis .. .. .	.. .. . 8s. 11d. per lb. (f.o.b.)
Titanium Ore—	
Rutile 95/97% TiO ₂ (prompt delivery) .. .. .	.. .. . £29 per ton c.i.f. Aust'n.
Ilmenite 52/54% TiO ₂ .. .. .	.. .. . £11 10s. per ton c.i.f. Malayan
Wolfram and Scheelite (65%) .. .. .	.. .. . 133s. 0d./138s. 0d. per unit c.i.f.
Vanadium—	
Fused oxide 95% V ₂ O ₅ .. .. .	.. .. . 8s./8s. 11d. per lb. V ₂ O ₅ c.i.f.
Zircon Sand (Australian) 65-66% ZrO ₂ .. .. .	.. .. . £16/£16 10s. ton c.i.f.

tude recently adopted by British Tungsten Ltd., selling agents for Board of Trade ore, who have been restricting sales. It is understood that their allotment for November has already been absorbed and that the quantity available in December will be limited to about 70 tons.

In New York the current quotation for foreign tungsten ore, c.i.f. U.S. ports, is \$17.00 nominal per s.ton unit.

IMPROVED OUTLOOK FOR INDIAN MICA

The export outlook for Indian mica is reported to be improving. After a prolonged slump, shipments have made an impressive recovery. According to the *Eastern Metals Review*, it is estimated that the total quantity exported during the first half of the current year amounted to 11,435 tons against about 8,800 tons in the preceding half year. Compared to the first six months of

1958, shipments during this period were higher by 625 tons. Indications are that exports for the whole year will exceed those of 1958, which totalled 19,610 tons.

ANTIMONY CONSUMPTION RECOVERS

U.K. consumption of antimony metal and compounds (in terms of antimony metal) made a good recovery in September to 409 t.ons from 305 tons in August, according to the British Bureau of Non-Ferrous Metal Statistics. Last year consumption of primary antimony in the U.K. totalled 4,740 t.ons.

All the main trades showed increases in September, with oxides for uses other than white pigments absorbing 90 tons against 50 in August, batteries 105 (85), antimonial lead uses other than batteries 47 (30), oxides for white pigments 111 (96), bearings 33 (26), miscellaneous uses 17 (13), and sulphides (including crude) six tons (five).

COPPER • TIN • LEAD • ZINC

(From Our London Metal Exchange Correspondent)

After early easiness in the undertone, all markets firmed up during the middle of the week but opinion is almost equally divided as to what the next week or so will bring forth.

COPPER FALLS ON L.M.E.

Copper has been the most active market with wide price movements brought about by the increased difficulty in understanding the strike situation in America, rumours about a possible release from the U.S. stock-pile, and extreme activity on Comex where operations on behalf of speculators have caused record turnovers and very violent fluctuations.

The developments in the strike situation in the U.S. are still limited to an increasing number of conferences between labour and management, except in the case of Phelps Dodge where an agreement has been reached with a group of craft unions but it is pointed out that this settlement can have no bearing on the main issues between the copper producers and the two main unions involved. It appears that hard bargaining is taking place between Kennecott and a united front of unions and perhaps between American Smelting and Refining and branches of unions at a number of its plants. It would appear that Anaconda have, as yet, made no move. The majority feel that although there is now a desire to settle the strike, it will be some time before any agreements are signed, but it is pointed out on the other hand that the workers themselves are becoming very restive and wish to get some money in their pockets before Christmas, and this being so, agreements may come suddenly.

In London, the market has declined almost continuously, the movement being helped by the fact that stocks in official warehouses were virtually unchanged at the beginning of the week against an anticipated drop of 6-800 tons, while the figures issued by the Copper Institute showed that the situation in America was better than had been expected and that the rate of production outside America

was increasing. The October figures issued by the Copper Institute gave a production of refined copper in America of 44,218 as opposed to 44,648 in September. Domestic deliveries fell sharply, probably due to the steel strike, and totalled only 68,648 against the September total of 92,501; partly because of this producers' stocks of refined copper at the end of October stood at 78,308 against 79,826 a month earlier. Outside the U.S., in spite of the strike in Chile, production of refined copper totalled 137,498 tons against 142,646 tons, whilst deliveries in October amounted to 142,297 against 139,781 in September and stocks at the end of October showed a decline of about 23,000 tons at 252,130 tons.

ACTIVE TIN MARKET AT STEADY PRICES

The tin market has again been active with prices remaining at the same level throughout the period and the quotations have also remained level in spite of a fall of 499 tons in the stocks in official warehouses, which stood at the end of last week at 7,131 tons. At the end of last week the Buffer Stock Manager issued a statement through the Chairman of the L.M.E. in reply to an article in the *London Financial Times* which had indicated that the Buffer Stock of tin might be as low as 3,000 tons. The statement was that both this figure and previous estimates of 6-6,500 tons were equally misleading. Attention was also drawn to the fact that the Board of Trade were due to release another 2,500 tons for sale by the Buffer Stock Manager and that the International Tin Council were ready to take action to prevent the price of tin rising to a level which they consider not in the best interests of the trade.

The Board of Trade announced the following day that they were disposing of 2,500 tons of tin through the Buffer Stock Manager and that the tin would be available to him from December 28, 1959, and it is understood that there is no obligation to spread the sales of this tonnage over any specified period. Con-

sumer demand from Europe remains good and although purchases by American interests have not been heavy, they too have been steady.

On Thursday the Eastern price was equivalent to £807½ per ton c.i.f. Europe.

FIRM LEAD-ZINC MARKETS

The lead market has once again developed a firmer undertone and with the quotations level a further rise in the price would not be unexpected, although basically the position of the metal is still one of over-availability, with the probability that this will be increased in the event of any steps having to be taken in the case of zinc. Mines in the U.S. produced 20,300 tons lead in September, which was 6 per cent below the August figure and slightly below the average monthly output during the first eight months of the year.

The zinc market has remained firm and the shortage was underlined by a Board of Trade announcement on Wednesday that they were selling 3,000 tons of G.O.B. zinc to the agent of the original suppliers of the metal and the market's reaction to this. In view of the difficulties in quickly assembling a meeting of producers, it is to be expected that the market will remain short of metal for some time to come and it may be that further releases by the Board of Trade will be made. There are still no signs of the arrival of any considerable tonnages of zinc from outside the U.K. which, in view of the existing back-wardation, indicates that supplies are universally short.

U.K. STATISTICS

The British Bureau of Non-ferrous Metals Statistics issued the following figures for U.K. non-ferrous metals for the month of September: the corresponding figures for August are in brackets:

Consumption of copper 57,367 (40,621)
End of month stocks ... 77,803 (89,483)
Offtake of Lead 30,255 (23,358)
End of month stocks ... 63,121 (66,048)
Zinc usage 31,270 (21,566)
End of month stocks ... 40,995 (40,358)
Tin offtake 2,073 (1,224)
End of month stocks ... 10,624 (10,752)

The most interesting development was the very much heavier shipments of copper to the United States, which in September totalled 8,656 tons, exceeding the tonnage shipped during the whole of last year.

Closing prices are as follows:

	Nov. 12		Nov. 19	
	Buyers	Sellers	Buyers	Sellers
COPPER				
Cash	£259	£259½	£245	£245½
Three months ..	£247	£247½	£236	£236½
Settlement ..	£259½		£245½	
Week's turnover	12,500 tons		13,275 tons	
LEAD				
Current ½ month	£71	£71½	£72½	£72½
Three months ..	£71½	£72	£72½	£72½
Week's turnover	10,675 tons		6,755 tons	
TIN				
Cash	£798½	£799	£797	£797½
Three months ..	£798½	£799	£796½	£797½
Settlement ..	£799		£797½	
Week's turnover	2,615 tons		685 tons	
ZINC				
Current ½ month	£96	£96½	£94½	£95
Three months ..	£90	£90½	£89½	£90
Week's turnover	4,875 tons		6,100 tons	

Mining Finance

Wankie Looks At Kariba

It is rare for there to be such direct competition in the fuel field as exists between Wankie Colliery and the Kariba hydro-electric scheme. As a result of geological and hydrological factors, almost all electricity generated in the Federation derives from one or other of these sources, and competition is intensified by the absence of export facilities for Wankie coal, in spite of frequent efforts to develop overseas markets.

Fortunately, the competition is carried on in a spirit of peaceful coexistence. Nevertheless, Kariba electricity presents a grave threat to Wankie's profits, and it is therefore interesting to know the views of the company on the probable future trend of demand.

Mr. Coulter, the chairman, says that the year to August, 1960 should show rather better coal sales than have been the case recently (sales in the past financial year totalled 3,618,617 tons of coal). Thereafter, the effect of Kariba will become more marked, and a low point in coal consumption may be reached in 3-4 years time. After this, however, general economic expansion should halt the trend, and possibly even reverse it.

It is therefore clearly of the utmost importance that the Wankie balance sheet is strong, and certainly the current position, with liquid assets exceeding liabilities by some £3,800,000 ensures a large measure of stability. Indeed, the £4,000,000 mark should be passed next year.

The current price of Wankie shares is 12s. 3d. It needs a courageous investor to buy in the knowledge that profits are soon going to decline sharply. Nevertheless, the present dividend rate of 1s. 3d. per share should not be in serious jeopardy unless the Anglo American coal economists are sadly wrong, and the current 10 per cent yield is some insurance against this contingency.

ANGLOVAAL HIATUS

As in each year since 1952, the annual report of Anglo-Transvaal Consolidated shows a steady advance on all fronts. Compared with last year, however, the rate of expansion has slowed down to some extent. Dividend income is only £36,000 up, compared with an improve-

ment of £203,000 recorded last year. Sharedealing profits are actually down, from £53,897 to £1,578 if the "special" profit of £314,625 from the A.S.A.I.T. deal is excluded, and if the interest, fees, commissions and sundries had not risen substantially, the accounts would have presented a not entirely happy picture of the year's operations.

Anglovaal is, of course, a rather unusual member of the big seven mining houses. Its ventures in the O.F.S. and Klerksdorp have met with rather less than their due measure of success. Both of the group's O.F.S. mines, Virginia and Merriespruit, have been disappointing, and the latter company is now under water with little prospect of resuming independent production. Until recently, it looked as though Hartebeestfontein would more than compensate for the O.F.S. troubles, but the recent difficulties in the deep area of the property and the resulting increases in capital spending have lifted this mine into the 10 per cent yield bracket. Only Loraine, taken over from Anglo American last year, and Zandpan, still shaft-sinking, remain as potential successes.

To set against this, however, Anglovaal probably has a bigger proportionate stake in general industry than any other of the houses. The range covered by group companies is truly remarkable, extending from cement to fishing vessels and from plastics to tinned foods. With this spread of interests, and the prospect of a renewed advance next year when the effects of the late recession in South Africa have been worked off, the 6 per cent yield of the shares looks high for such a vigorous company.

LONDON MARKET HIGHLIGHTS

The pattern of the South African Gold share market during the week was again one of almost complete indifference in London matched by a steady buying support from Johannesburg. Net result was that most prices tended to ease back here. Certain dividend payers were however very firm with good gains seen in Durban Deep (U.S. buying suspected here) at 39s. 6d., Marievale (29s. 3d.) and East Rand Proprietary (43s.).

Newer mines in the O.F.S. and Western Rand were left out of the picture. Those predominantly interested in uranium suffered from fears that the Canadian "stretch-out" contract arrangements would make life difficult for South African mines in post-contract markets.

Premiums on the new Leslie and Bracken shares were altered to 8s. 3d. and 15s. 6d. respectively; it appeared that some shareholders were selling their Leslie rights in order to take up their entitlements in Bracken.

The Finance group was almost uniformly dull, although Gold Fields (89s. 3d.) brightened a little following the report. Anglo American, however, fell 6s. 3d. to 197s. 6d., a move that was not helped by the sudden weakness in De Beers.

News of the De Beers venture into the synthetic diamond field was initially greeted by a rise of 2s. 6d. to 196s. 3d. Later it was decided that the project was not necessarily a bull point for the shares after all (particularly in view of the strong lead in synthetic production held by G.E.C. of America) and De Beers promptly dropped to 188s. 9d.

Elsewhere, the market welcomed the long awaited maiden dividend of Algom

which was \$2.50. Another Canadian uranium stock in the Rio Tinto group, Pronto, declared 50 cents to make \$1 for the year. Tanganyika Central, also dependent on uranium for the larger part of its revenue, announced that it was to tackle accumulated losses by writing down its £210,000 capital by half. New Modder, now in liquidation, announced a first and final distribution of 1s. 4.896d. tax free.

Copper share prices drifted lower with the setback in the metal price, but rallied later. Messina fulfilled most expectations by declaring a final dividend of 100 per cent to make 180 per cent on the 5s. shares and there was also a maiden 5 per cent on the 5s. shares of the young Mangula mine. Less happy was the news of continued problems in treatment tests on the complicated Kansanshi ore. This lowered Rhodesia-Katanga (whose principal holding is a 35 per cent stake in Kansanshi) to a rather nominal 13s. 1½d. after 10s.

Tins became irregular as profit-taking developed. Both the Sungei Besi dividend (equivalent to 8d. per 4s. share after allowing for the earlier scrip issue) and the financial results were considered to be quite satisfactory. So was the Ayer Hitam increased total of 2s. (against 1s. 3d.) on 5s. shares. Also encouraging was the rise in profits accompanied by a higher payment of 12½ per cent from Pahang, Malaya's lode tin mine.

Otherwise, lead-zincs stayed depressed with buyers taking a cautious view of the recovery prospects for the twin metals, although news of the Board of Trade zinc stockpile release had no adverse effect on the metal market.

"RESTRAINED SATISFACTION"

With characteristic understatement, Mr. J. N. Davies, chairman of Malaya's only major lode tin mine Pahang Consolidated, says that "in view of the difficulties which have beset the tin mining industry and the heavy restriction on output imposed by the international tin agreement", the accounts for the 1958/9 financial year were presented "with a measure of restrained satisfaction". By any other standards but Mr. Davies', Pahang's latest financial year would be accounted a thumping success, if only because the balance available for appropriation increased from £9,266 to £101,670, making it possible to distribute £80,718 in dividends (12½ per cent on the ordinary shares) compared with £18,400 last year.

The main factor that has made this recovery possible is not, as might be thought, an improvement in tin revenue, but the tight hold that Pahang has managed to keep on costs, and particularly overheads, in the recent difficult years. Between 1956-7 and 1958-9, production had to be brought back from 195,800 tons mined and hoisted to 117,300 tons. Yet over the same period, costs per ton crushed rose by only \$M1.63 to reach \$M48.10. Behind this figure lies the fact that mining, milling and development costs rose by some \$M4.50 per ton, but "general expenses" were actually reduced from \$M12.97 per ton to \$M12.73 per ton. In terms of tin produced, costs went up by only \$M27 per ton (about £3.3s.), from \$M3,121 to \$M3,158. This is cause indeed for "restrained satisfaction".

Pahang are currently priced at around 8s. 6d. to yield 7 per cent. With the improving picture for tin generally and the special factors applicable to this company, this could look very cheap in a year's

time, even though the present price is almost three times the low spot reached earlier this year. Ore reserves are adequate, and development continues to be satisfactory, while this year's report contains news of prospecting outside the Pahang boundary which, though still at an early stage, appears promising.

CASTS PRELIMINARIES

Depending on how the figures are interpreted, Casts are either increasing or cutting their distribution for 1958-9. This unusual position arises as a result of the special interim of 1s. declared on account of 1957-8, but paid out of the 1958-9 profits without prejudicing the normal payments for that year. The recommended final dividend this year is 2s. 6d., so that the 1958-9 total can be regarded as either 3s. 3d. or 4s. 3d., compared with a 1957-8 total of 2s. 6d. or 3s. 6d. Probably the best way to treat the situation is to consider the special interim as a bonus. In this light the comparison is between 3s. 3d. and 2s. 6d., although were it not for last year's change in profits tax rates, the payment might have been increased to nearer this year's level.

There is no such confusion over Casts' profits. After tax, these have increased once more, this time from £1,159,614 to £1,307,134. This is stated to be the result of increased revenue from diamond sales by Sierra Leone Selection Trust.

GOLD FIELDS KEEP MUM

There will be disappointment among investors who turn to the report and accounts of Consolidated Gold Fields hoping to learn more about the reorganization which this group has been undertaking this year. The various acquisitions are mentioned only in passing, and, it must be assumed, the speech by Mr. Robert Annan, the chairman, is going to be the medium through which the company expresses its future plans.

In the meantime, a further step towards rationalization is being planned. Changes in company legislation since 1919 have rendered unnecessary the two-company structure now existing. At the same time, the articles of association have become obsolete, so an extraordinary meeting is to be held after the annual meeting on December 10 at which, shareholders approving, the assets of New Consolidated will be transferred to Consolidated Gold Fields, and, at the same time, the articles of association will be modernized.

Two of the new articles are somewhat interesting. Firstly, it is proposed to remove the restrictions on voting which previously applied to shareholders of less than two months standing. This obviously implies that the presence of Mr. Drayton and his associates has removed the vulnerability to take-over which must have been a problem on the mind of Gold Fields' board for some considerable time.

Secondly, power is being sought for the appointment of a president, executive directors and more than one deputy chairman. Who, one wonders, is going to occupy which chair?

METALLURGICAL PROBLEMS AT KANSANSHI

The Rhodesia-Katanga Company has issued a further statement on the efforts

being made to overcome the metallurgical problems raised by Kansanshi's refractory ore. The roasting and leaching sections of the pilot plant have been completed, the statement says, but preliminary tests have been disappointing.

In view of these results it has been decided not to incur the extra expense of full pilot plant testing until the whole economic picture presented to date has been examined. Consideration is being given to alternative methods of treatment, but the future of the unlucky Kansanshi property is as doubtful as ever.

Same Payment from Lake View and Star.

—In spite of an improvement in mining profit from £395,293 to £403,788 in the year to June 30, 1958, Lake View and Star is to recommend a final dividend of 1s. 6d. per share, making an unchanged total of 2s. 6d. Depreciation absorbed £12,000 more at £55,440, but this was largely offset by a reduction in the taxation charge from £139,000 to £129,000. Balances carried forward are now £75,905 (normal) and £13,882 (non-mining). Meeting, December 16.

More Kaffirs on American Stock Exchanges?—Mr. Edward McCormick, president of the American Stock Exchange, is

at present visiting South Africa. The purpose of his visit, he told a Press conference in Johannesburg, was to investigate the possibility of listing South African gold shares on the American Exchange.

Lydenburg Gold Farms Rights Issue.

Because it is felt that the company needs new working capital in order to strengthen its investment portfolio and also to enable it to take up any participations resulting from its land holdings, Lydenburg Gold Farms is proposing a rights issue of 2s. 6d. shares at 3s. 9d. Two new shares will be available for every five currently in issue, and the proceeds before deducting expenses will be £187,500. In the absence of unforeseeable factors, the board thinks that it should prove possible to maintain the current dividend rate of 10 per cent in the increased capital, although, of course, there is no guarantee as to the repetition of last year's bonus of 5 per cent. Profit for the year to June 30 last came to £79,054 after tax, compared with £49,998 in 1957-8.

Less from Ipoh.—Ipoh Tin Dredging is reducing its payment for 1958-9 to 1s. per share. This compares with 2s. per share in the two preceding years. Net profit for the year to March 31 last amounted to £21,185 compared with £32,984 in 1957-8. Meeting, March 31, 1959.

(continued on page 521)

THE PERAK RIVER HYDRO-ELECTRIC POWER COMPANY

ADVERSE EFFECT OF TIN EXPORT CONTROL REGULATIONS

The 33rd annual general meeting of The Perak River Hydro-Electric Power Company, Limited, was held on November 12 in London, Mr. Hugh G. Balfour (the Chairman), presiding.

The following is an extract from his circulated statement:—

The Company's operations during the year ended July 31, 1959, were adversely affected to a greater degree than during the previous year by the tin export control regulations under the International Tin Agreement. It is calculated that during our previous financial year ended July 31, 1958, the permissible exportable amount of tin for Malaya was 46,400 tons, while in the year under review the exportable amount was reduced by 30 per cent to 32,521 tons, representing what is known as a quota rate of 54.6 per cent on the basic Malayan output of 59,569 tons under the tin export control scheme.

Over 85 per cent of the Company's output of electricity is taken by the tin mining industry, and there is a direct relationship between the operation of the tin restriction scheme and the volume of the Company's business. Last year the number of units sold was 331.8 millions as compared with 230.2 millions for the year under review, a decrease of 101.6 million units or 30 per cent, corresponding to the reduction in the exportable amount of tin for Malaya.

Chenderoh Station

The year was an exceptionally bad water year, the average effective river flow in the Chenderoh River having been the lowest for 29 years. As a result only 142 million units were generated at the Chenderoh hydro-electric power station, which is 18½ per cent less than in the previous year. Under reasonable river conditions we expect to obtain 190 million units from the Chenderoh Station

in a normal year, so there was a shortfall of 48 million units which had to be generated in our thermal power stations. In 1950 a Fuel Equalization Reserve was created to offset the effect of abnormal conditions of river flow on the cost of generation in our thermal power stations, and since 1955 this Reserve has stood at £100,000. In view of the abnormally low water conditions this year we propose to draw £24,693 which has been placed to the credit of Net Revenue Account.

The two new 12 mW generating sets at Malim Nawar Power Station with ancillary boiler plant, water cooling tower, etc., were brought into operation during the year under review. Our Vice-Chairman, Mr. Donald Brook, visited Malaya to attend the official opening of the Malim Nawar extension by the then Prime Minister of the Federation of Malaya, the Honorable Dato Abdul Razak bin Hussain, which took place on May 18, 1959. The Board are grateful to the Prime Minister for undertaking this function, particularly in view of the pressure of his duties immediately prior to the elections in the Federation.

Our subsidiary company, The Kinta Electrical Distribution Company, Limited, continued to expand its business, although the average demand from consumers was slightly reduced.

Since the end of our financial year the permissible export amount of tin for Malaya for the period to the end of December, 1959, has been increased, and now represents a quota rate of 71 per cent, as compared with an average quota rate of 54.6 per cent during the year under review. If these better conditions continue the outlook for the current year should be more promising than for the year to July 31 last.

The report was adopted and a dividend of 5 per cent approved.

WANKIE COLLIERY COMPANY LIMITED

(Incorporated in Southern Rhodesia)

PROFITS MAINTAINED DESPITE LOWER COAL SALES

The following are extracts from the review by Mr. T. Coulter, the chairman, which has been circulated with the report and accounts:

The profit for the year before taxation, but after providing for depreciation, debenture interest, debenture trustees' fees and directors' emoluments, was £1,372,044. This shows a small increase of £2,693 compared with last year which was brought about in part, despite lower sales tonnages, by an improvement in revenue from interest. At the end of the year there was a deficiency revenue of £91,024 which in terms of the coal price agreement is recoverable in future years.

A sum of £500,000 was provided for taxation, of which £45,000 has been transferred from the taxation equalization reserve, and the balance of £455,000 provided from the profit for the year.

An amount of £285,000 was transferred to general reserve in conformity with the terms of the price agreement, and an amount of £100,000 has been transferred from general reserve to a new reserve specifically created to meet increased costs of replacements and obsolescence of assets.

Your directors have declared two dividends during the year. The total distribution was £659,726, which represents 1s. 3d. per share. There has been a reduction of the balance of £366,958 unappropriated profit at the end of last year by £27,682 to a figure of £339,276.

Current assets, not including stocks and stores, at £4,548,411, indicate a surplus of £3,485,437 as against current liabilities of £1,062,974.

Sales

The Company's financial year was given a bad start by heavily reduced sales during October and November, 1958, due to the Copperbelt strike. It is calculated that some 150,000 tons of trade were lost. General sales were at a lower level than for the previous year but an appreciable increase in demand during July and August helped to bring total sales output to 3,618,617 tons, only 293,274 tons less than for 1958. In view of the fact that export afforded no contribution to the sales output the result under all the circumstances is not unsatisfactory.

Our estimates indicate that the year ending August, 1960, should show a rather higher coal consumption in the Federation than we have experienced recently. Thereafter, as the impact of power generation at Kariba becomes more marked, demand from thermal stations and consequently the railways will fall and internal requirements are likely to decline to a low point in three or four years' time.

After this, however, it seems probable that increased demands from the general trade flowing from future industrial expansion will overtake the fall in requirements for thermal power purposes and reverse the trend, and may even maintain thermal power generation for some time at reasonable levels. In this connection it is satisfactory to note that in some of the model African townships now being planned, the use of

solid fuels for heating and cooking purposes is envisaged. The Company is giving considerable attention to the distribution of coal amongst Africans and to their education in the use of coal.

It is obvious, however, that the Company will have to face several difficult years, but provided the position is as we see it at the moment we hope that, by drawing on unappropriated profits and with the assistance of our rising investment income, we will be able to maintain dividends at their present level.

We have continued our efforts to obtain export markets without achieving any great success. World coal surpluses have resulted in the development of a highly competitive market and the colliery's long distance from the port of Lourenco Marques remains a considerable handicap.

In order to explore the South American market, the Company's managing director, Mr. Logan Wishart, recently accompanied a South African delegation to that part of the world. Whilst no immediate sales have resulted from the visit many useful discussions were held and a degree of goodwill was established which will facilitate future negotiations.

Coal Price

The notified average selling price of coal within the Federation, which in terms of the price agreement was fixed at 19s. 6d. per ton on November 1, 1958, has remained unchanged during the year. Earlier this year, however, we were asked by the Southern Rhodesia Government to consider the possibility of arriving at a stabilized coal price which would apply for a period of two years from November 1, 1959.

After making detailed and careful estimates it was agreed with the Government that the average notified price would be 20s. per ton for the period November 1, 1959, to October 31, 1961, subject to the Company's right to apply for a revision of the price in the event

of any unforeseen factors arising during that time.

The stabilization of coal prices in the Federation will be of considerable assistance to industrial consumers in planning future development, and it is hoped that as a result coal usage will increase. Our estimates show, however, that an average price of 20s. per ton is likely to result in the accumulation of further deficiency revenue by the end of the two-year period. Such deficiency of revenue is, in terms of the price agreement, recoverable in future years.

Last year I stated that the estimated maximum possible coal demand up to the start of power generation at Kariba in 1960 was not likely to exceed a rate of some 4,500,000 tons per annum. Now the indications are that this estimate was optimistic, although it is possible that for a short period immediately before Kariba power becomes available the demand rate may approximate that figure.

General

Investments now include an interest in Clay Products Limited. This company owns and operates a factory near Bulawayo producing first quality salt glazed ware, and the investment is expected to show satisfactory returns in future years.

The production of coke has for many years formed an important part of our undertaking, but, as with coal, demand has shown a decline over the last two years. One of the larger consumers of coke, The Rhodesian Iron and Steel Company Limited, is at present proceeding with the erection of its own coke making plant, which will result in a further reduction in demand during the current year. On the other hand, we can anticipate a corresponding increase in coal demand from that company for coke production, and long term estimates show that the overall market for our coke will eventually exceed the previous maximum tonnage sold.

Sales of "Wankie" tar from the by-products plant at No. 1 Colliery have increased by almost 100 per cent., and our output is fully sold for some further 12 months. With the rapid development of road communications in Central Africa, we can look forward to a continuing demand.

METALLURGICAL ASSISTANTS

ROAN ANTELOPE COPPER MINES LIMITED

NORTHERN RHODESIA

The above-mentioned company invites applications from metallurgists holding a degree or equivalent qualification and several years' experience in milling and flotation or allied operations. Duties will cover practical operating and supervision in all sections of the concentrator.

Starting salary range £1,092 to £1,320 per annum depending on experience. There is also a variable bonus, at present 36½ per cent on basic salary and a cost-of-living allowance, currently £65 per annum. Other benefits include contributory pension and life assurance scheme, hospital and medical services; share purchase and house purchase schemes.

Married accommodation at nominal rental immediately available.

Employee's outward passage to Rhodesia is paid by the company.

Applications giving particulars of age, qualifications and experience should be addressed to:—

Mine Employment Department,
SELECTION TRUST LIMITED,
Mason's Avenue, Coleman Street, London, E.C.2.

Please quote R.27 M.J.

Financial News and Results

(Continued from page 519)

London and African Earnings and Pays More.

—From earnings of £20,392 in the year to September 30, 1959, London and African is recommending a dividend of 3d. per share. This compares with profits of £15,890 and a payment of 10 per cent for 1957-8. Last year it was stated that over 50 per cent of the company's capital was invested in Mines Development Syndicate, which owns a lead-zinc property in Nigeria in which a number of mining groups have been stated to be interested.

Tin Fields Sells Up.—The highest offer received by Tin Fields of Nigeria for its properties and other assets in Nigeria was £12,100 and this offer has been accepted. Shareholders will be advised in due course of the directors' recommendations for the future policy of the company.

Senior and junior geologists required for field work in North Borneo by Prospecting Company. Tours of service 12 to 15 months. Salary according to qualifications and experience. Write giving full details, experience, etc., stating age and whether married or single, to Box 148, c/o Barker and Howard, Ltd., 79 Fenchurch Street, London, E.C.3.

MINE ENGINEER
REQUIRED FOR LARGE
MINE PRODUCING BASE
METAL IN IRELAND

Duties will include supervision, mine-planning, lay-out and the preparation of incentive systems. Applicants should be graduates with at least five years engineering experience in operating mines. First letter should give fullest details of age, experience, marital status, etc. Salary will be commensurate with ability and experience. Apply to Box No. 648, *The Mining Journal Ltd.*, 15 Wilson Street, Moorgate, London, E.C.2.

GEOLOGIST AND
GEOLOGIST/GEOCHEMIST

Experienced Geologist and Geologist / Geochemist required for field mineral exploration in large concession area in Bechuanaland. Starting salary £1,500-£1,800 p.a. depending on qualifications and experience. Leave at 6 weeks p.a. may be accumulated up to 18 weeks. Field Allowance, bonus, pension and medical schemes. Apply in writing to:—

**Business Manager,
Rhodesian Selection Trust
Exploration Limited,
P.O. Box 1479,
Salisbury, Southern Rhodesia.**

Rand and Orange Free State Returns for October

GOLD OUTPUT AND PROFIT

Company	October 1959			Year ends	Current Financial Year Total to date			Last Financial Year Total to date		
	Tons (000)	Yield (oz.)	Profit (£000)		Tons (000)	Yield (oz.)	Profit (£000)	Tons (000)	Yield (oz.)	Profit (£000)
Gold Fields										
Doornfontein.....	95	38,575	191-0	J	379	153,822	761-1	350	146,119	773-7
Libanon.....	112	26,413	62-7	J	439	102,971	242-9	392	92,279	218-2
Luipaards Vlei.....	71	12,658	5-8	J	290	51,222	23-2	280	48,101	21-4
Rietfontein.....	16	4,304	8-1	D	160	42,370	75-5	214	49,310	123-5
Robinson.....	56	11,032	L 1-0	D	582	121,712	L 71-4	724	153,591	28-7
Simmer & Jack.....	82	16,433	8-1	D	857	163,751	L 31-6	879	167,756	139-7
Sub Nigel.....	66	15,751	20-5	J	264	63,154	86-7	264	63,961	102-2
Venterspost.....	126	32,017	62-6	J	511	128,229	246-9	521	128,530	242-1
Vlakfontein.....	52	18,612	88-6	D	507	182,046	861-4	496	175,146	848-7
Vogels.....	90	19,611	28-3	D	914	204,708	356-5	955	213,472	439-9
West Drie.....	107	97,987	826-3	J	405	370,608	3098-6	320	305,591	2501-6
Anglo American										
Brakpan.....	143	17,186	13-1	D	1,390	168,158	114-1	1,239	165,360	120-3
Daggas.....	238	47,600	230-5	D	2,401	482,916	2361-5	2,321	481,858	2529-1
East Daggas.....	104	17,679	40-2	D	1,004	168,183	338-7	914	151,300	282-5
F.S. Geduld.....	93	77,429	604-6	S	93	77,429	604-6	74	54,093	390-4
President Brand.....	117	96,233	852-5	S	117	96,233	852-5	98	72,473	605-7
President Steyn.....	104	41,288	195-7	S	104	41,288	195-7	94	37,158	195-7
S.A. Lands.....	97	20,225	55-1	D	967	202,096	568-1	896	194,153	531-3
Springs.....	105	14,453	15-4	D	1,041	142,611	130-5	1,274	144,035	87-4
Vaal Reef.....	100	45,000	240-3	D	898	405,437	2141-8	725	327,497	1856-6
Welkom.....	98	30,949	79-4	S	98	30,949	79-4	90	27,120	78-3
Western Holdings.....	136	86,340	686-6	S	136	86,340	686-6	100	57,003	424-1
West. Reef Ex.....	141	38,205	127-6	D	1,310	344,322	1040-8	1,115	265,073	642-8
Central Mining										
Blyvoor.....	129	86,105	652-1	J	522	340,791	2572-4	417	271,699	1968-0
City Deep.....	112	23,522	8-0	D	1,151	239,640	95-7	1,286	253,400	104-1
Cons. M.R.....	91	17,270	7-0	J	395	73,739	31-5	529	82,550	57-2
Crown.....	223	35,942	19-1	D	2,215	351,700	136-8	2,303	350,961	155-6
D. Roodepoort.....	200	36,616	54-3	D	1,916	353,845	535-7	1,827	330,734	512-6
East Rand Prop.....	220	38,000	109-1	D	2,211	575,196	1191-6	2,143	567,478	1463-0
Harmony.....	141	36,053	247-9	J	566	223,956	1014-4	381	151,909	587-3
Modder East.....	142	13,708	2-5	J	568	54,517	11-4	548	53,700	7-7
Rose Deep.....	31	5,042	L 0-8	D	384	52,868	L 1-8	580	71,546	L 23-9
J.C.I.*										
Freddies Cons.....	64	14,775	L 36-4	D	594	142,586	L 369-8	528	150,505	L 392-9
Govt. G.M.A.....	54	11,046	0-8	D	534	107,210	L 11-8	625	111,741	5-6
Randfontein.....	33	5,556	5-2	D	356	60,979	84-2	274	44,011	50-8
Union Corporation										
East Geduld.....	143	42,195	285-7	D	1,388	415,458	2799-6	1,287	395,807	2706-1
Geduld Prop.....	78	14,955	41-0	D	735	138,725	288-8	785	128,675	114-5
Grootvlei.....	225	47,025	253-4	D	2,130	449,480	2326-3	1,975	420,260	2140-7
Marievale.....	100	24,100	122-8	D	947	232,501	1144-8	728	190,523	848-1
St. Helena.....	160	50,809	300-1	D	1,510	460,938	2547-5	1,195	350,496	1783-6
Van Dyk.....	74	13,509	26-7	D	752	141,461	276-8	766	141,249	255-4
Winkelhaak.....	83	23,028	77-1	D	760	192,701	448-2	—	—	—
General Mining										
Buffelsfontein.....	145	55,618	292-8	J	577	219,648	1147-9	477	160,852	739-0
Ellaton.....	30	6,949	26-9	D	311	72,199	289-1	320	74,396	318-4
S. Roodepoort.....	31	7,273	23-6	J	121	28,728	92-2	121	28,330	98-1
Stilfontein.....	160	72,096	400-5	D	1,434	686,870	4089-5	1,149	571,467	3703-0
W. Rand Cons.....	145	20,576	18-8	D	1,381	199,935	181-6	1,379	183,458	145-9
Anglo Transvaal										
Hartebeestfontein.....	102	52,020	322-3	J	372	196,455	1258-3	348	190,530	1266-9
Lorraine.....	82	16,400	L 18-2	S	82	16,400	L 18-2	74	14,430	L 19-3
N. Klerksdorp.....	10	1,170	L 7-1	D	103	11,237	L 85-0	101	10,983	L 77-7
Rand Leases.....	195	28,860	30-1	J	780	115,143	116-2	718	104,545	44-0
Village M.R.....	32	4,820	1-2	J	118	18,946	4-6	110	18,758	1-0
Virginia O.F.S.....	132	30,195	15-2	J	532	122,697	53-1	437	114,457	185-6
Others										
N. Kleinfontein.....	85	10,874	3-1	D	828	107,561	31-0	874	107,059	L 25-1
Wit Nigel.....	19	4,381	5-2	J	73	17,525	20-7	72	17,289	L 25-9

Gold has been valued at 249s. 6d. (September 250s. 0d.) per oz. fine. L indicates loss. † Working Profit. * Working Profit includes sundry revenue. Table excludes profits from Uranium, Pyrite and Acid, and also production from Uranium divisions at Luipaards Vlei, Randfontein and W. Rand Consolidated.

ESTIMATED URANIUM REVENUE

Company	Year ends	Oct. Profit (£000)	This year (cum.) (£000)	Last year (cum.) (£000)	Company	Year ends	Oct. Profit (£000)	This year (cum.) (£000)	Last year (cum.) (£000)
Gold Fields					J.C.I.				
Doornfontein.....	J	15-0	58-0	60-0	E. Champ d'Or (b)	D	7-1*	68-4*	60-5*
Luipaards Vlei (a)	J	94-0	373-0	358-0	Freddies Cons.....	D	37-0*	352-0*	281-0*
Vogels.....	D	54-0	525-0	532-0	Govt. G.M.A.....	D	22-7*	221-7*	244-3*
West Drie.....	J	50-0	200-0	184-0	Randfontein (a)...	D	110-0*	1068-3*	1101-9*
Anglo American					General Mining				
Daggas.....	D	135-0	1379-3	1403-0	Buffelsfontein.....	J	211-0	847-0	771-0
President Brand.....	S	44-8	44-8	52-0	Ellaton.....	D	17-0	180-0	161-0
President Steyn.....	S	59-2	59-2	63-0	Stilfontein.....	D	86-0	857-0	910-0
Vaal Reef.....	D	146-7	1430-3	1226-0	W. Rand Cons. (a)	D	206-4	2017-6	2244-3
Welkom.....	S	56-3	56-3	62-0	Anglo Transvaal				
West Reef Ex.....	D	161-1	1590-8	1531-0	Hartebeestfontein.....	J	258-0	1054-6	1061-7
Central Mining					Lorraine.....	J	36-0	36-0	35-0
Blyvoor.....	J	156-0	612-4	624-4	N. Klerksdorp.....	D	11-0	109-5	119-5
Harmony.....	J	192-1	791-4	536-7	Virginia O.F.S.....	J	178-8	707-0	742-9

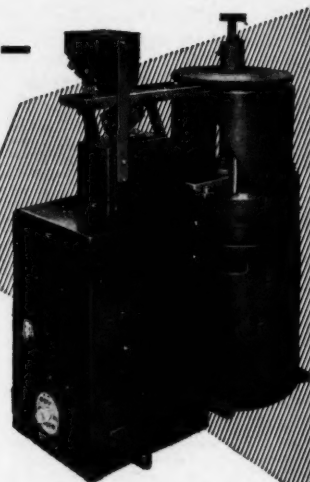
Table includes profit from uranium, acid and pyrite before loan redemption. (a) Total profit from uranium section. (b) Overall profit. * Net revenue after provision for loan redemption.

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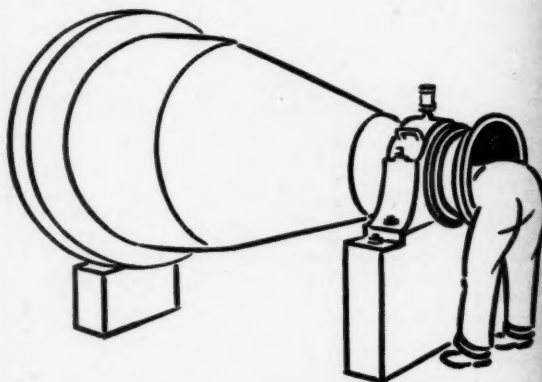
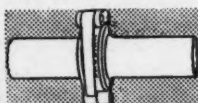
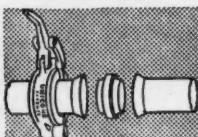
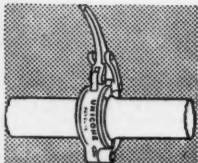
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